CA2ALFLW62
91W04

Management Plan for Wolves in Alberta

Wildlife Management Planning Series Number 4

Alberta

MANAGEMENT PLAN FOR WOLVES IN ALBERTA

Wildlife Management Planning Series
Number 4

December 1991
Edmonton, Alberta

Forestry, Lands and Wildlife
Fish and Wildlife Division

Pub. No.: T/237
ISBN: 0-86499-804-X

For copies of this report, contact:

Information Centre
Alberta Energy/Forestry, Lands and Wildlife
Main Floor, Bramalea Building
9920 - 108 Street
Edmonton, Alberta, Canada T5K 2M4

Telephone: (403) 427-3590

OR

Information Centre
Alberta Energy/Forestry, Lands and Wildlife
Main Floor, Bantrel Building
703 - 6th Avenue SW
Calgary, Alberta, Canada T2P 0T9

Telephone: (403) 297-6324

92-07127/

PREFACE

The plan presents the Fish and Wildlife Division's goals, objectives and management strategies for the management of wolves in Alberta, and will be updated periodically and revised as necessary. Implementation will be subject to divisional priorities established during the budget process.

TABLE OF CONTENTS

	Page
1.0 INTRODUCTION	1
2.0 BACKGROUND TO THE PLAN	3
2.1 History	3
2.1.1 Historical Populations	3
2.1.2 Highlights of Historical Wolf Management in Alberta	9
2.2 Biology	12
2.2.1 Taxonomy	12
2.2.2 Distribution	13
2.2.3 Description	14
2.2.4 Social Organization, Reproduction and Mortality	16
2.2.5 Population Dynamics	18
2.2.6 Dispersal, Movements and Territories	18
2.2.7 Predation	20
2.2.7.1 Food Habits	20
2.2.7.2 Predation and Consumption Rates	20
2.2.7.3 Prey Selection	21
2.2.7.4 Effect of Wolf Predation on Prey Populations	22
2.2.7.5 Predation of Livestock	23
2.2.8 Significance of Wolf Diseases	24
2.3 Status	26
2.3.1 Supply	26
2.3.1.1 Distribution and Numbers	26
2.3.1.2 Populations	29
2.3.2 Use	31
2.3.2.1 Fur Harvest	31
2.3.2.2 Recreational Hunting	33
2.3.3 Management	34
2.3.3.1 Bounty Management	34
2.3.3.2 Fur Management	36
2.3.3.3 Hunting Management	38
2.3.3.4 Nuisance/Problem Management	39
2.3.3.5 Predation of Ungulates	49
2.4 SUMMARY AND MANAGEMENT ISSUES	56
2.4.1 Summary	56
2.4.2 Management Issues	58

Table of Contents (cont'd) Page

3.0 MANAGEMENT PLAN 58

3.1 Policy Framework 60
3.1.1 Resource Protection 60
3.1.2 Resource Allocation 61
3.1.3 Recreational Use 61
3.1.4 Commercial Use 61
3.1.5 Protection of Private Property 61
3.2 Management Goals and Objectives 61
3.2.1 Resource Protection and Population Management ... 61
3.2.2 Resource Allocation 62
3.2.3 Commercial Use 62
3.2.4 Recreational Use 63
3.2.5 Protection of Life and Property 63
3.2.6 Science and Education 64
3.3 Management Strategies 64
3.3.1 Resource Protection 64
3.3.2 Resource Allocation 65
3.3.3 Fur Management 65
3.3.4 Hunting Management 66
3.3.5 Population Inventory 66
3.3.6 Management of Wolf/Prey Relationships 67
3.3.6.1 Wolf/Prey Dynamics 67
3.3.6.2 Wolf Popualtion Reduction for Ungulate Restoration 68
3.3.7 Protection of Private Property 70
3.3.7.1 Prevention 70
3.3.7.2 Control 71
3.3.7.3 Compensation 71
3.3.8 Control of Disease 72
3.3.8.1 Monitor Disease 72
3.3.8.2 Education 72
3.3.8.3 Control 72
3.3.9 Education and Science 72

4.0 MANAGEMENT PLAN APPLICATION 73

4.1 Provincial Summary 73
4.2 Regional Perspective 73
4.2.1 Southern Region 73
4.2.2 Central Region 74
4.2.3 Eastern Slopes Region 74
4.2.4 Peace River Region 74
4.2.5 Northeast Region 75

5.0 LITERATURE CITED 76

APPENDIX I 87

LIST OF TABLES

Table		Page
1.	Densities of wolves during winter in Alberta	27
2.	Summary of wolf complaints and wolves killed by Alberta Fish and Wildlife during 1972-90	40
3.	Numbers of wolf property damage complaints in Alberta	43
4.	Mortality of cattle and numbers of wolves on summer grazing leases in the vicinity of the Simonette River, northwestern Alberta	45
5.	Numbers of claims approved for payment and dollars paid for wolf predation of livestock in Alberta	48
6.	Summary of changes in wolf and big game populations and wolf control in Alberta during 1943-88	51
7.	Summary of wolf control/big game research in Alberta	52

LIST OF FIGURES

Figure		Page
1.	Changes in relative abundance of moose and wolves in Alberta with associated limiting and growth factors	10
2.	Wolf range in Alberta in 1986 with locations of intensive study areas during 1969-85	28
3.	Number of wolf pelts sold annually and average pelt prices in Alberta from 1930 to 1989	32
4.	Numbers of wolf complaints, livestock compensation payments and problem wolves removed in Alberta	41
5.	Trends in numbers of wolf complaints in five administrative regions in Alberta	42

ACKNOWLEDGMENTS

This plan, compiled by J. R. Gunson, was prepared for the Fish and Wildlife Division (R. R. Andrews, Director of Wildlife and B. J. Markham, Head of Planning and Game Management). Technical assistance was provided by Drafting Services (A. Ngan) and Cartographic Services (M. Bradley) of Alberta Forestry, Lands and Wildlife. Earlier drafts were critically reviewed by R. Bjorge, E. Bruns, J. Folinsbee, W. Glasgow, R. Hanson, R. McFetridge, B. Rippin, L. Russell, K. Smith, and A. Todd. Editorial services were by D. Ealey.

MANAGEMENT PLAN FOR WOLVES IN ALBERTA

EXECUTIVE SUMMARY

Historical Populations and Management

Wolves in Alberta experienced two cycles of scarcity and abundance during the past 100 years. Bounty-supported poisonings, trapping, shooting and a scarcity of ungulate prey produced very low populations, lasting from the late 1800s through the 1920s. From 1930 to the late 1940s, wolves increased dramatically to reoccupy western and northern forested habitats and created great concern for early wildlife managers as to the effect of their predation on game populations. The appearance of rabies in red foxes and coyotes in 1952 resulted in a massive carnivore population control program, which reduced numbers to 500-1000 wolves by 1956. Localized wolf control continued for enhancement of big game populations to 1966. During the 1960s, wolves again increased, fully occupying remote habitats by 1969 and the agricultural transition zones by the early to mid-1970s. During the 1980s and 90s, depressed moose, elk and caribou populations support fewer wolves.

Current Status

The wolf is recognized as a valued inhabitant of natural ecosystems and is often perceived as a symbol of the wilderness.

Current estimates of the provincial wolf population range from a late-winter low of 3500 to an early-summer high of about 5500 following the birth of pups. Wolf populations have been studied on seven intensive

study areas during the past 20 years and estimated densities on six of these areas (five with radio-collared wolves) ranged from 1 wolf/40 km^2 to 1 wolf/225 km^2.

Trappers have little incentive to harvest wolves because the natural wariness and great mobility of these animals make capture difficult and because poor pelt value results from coarse fur, black colour phases and occasional mange. The annual average of about 500 wolf pelts on the fur market in Alberta (many taken by landowners and hunters) is well below the estimated sustainable harvest. Incentives by government to increase fur harvest such as complimentary snares, special courses and provision of bait have been largely unsuccessful.

An annual average of 159 wolf complaints during 1972-90 (range 74-231) were investigated by divisional staff. Most complaints involved harassment or predation of livestock. This livestock depredation is dealt with by the Alberta Livestock Predator Compensation Program [average annual payments of $49 986 (N = 16 years)] and by removal of offending lone wolves or packs, mostly by strychnine poisoning [annual mean of 67 wolves removed (N = 18 years)].

Research in Alberta has identified wolf predation as an important limiting factor to populations of woodland caribou in the Willmore-Grande Cache area, elk in the Brazeau-Blackstone rivers area of the Eastern Slopes and moose near Fort McMurray.

Management Policies, Goals, Objectives and Strategies

1. Regional population goals are established to maintain a winter

population of 4000 wolves in the long term. In southwestern Alberta, wolf management will include assistance to wolf recovery programs in the northwestern USA. On certain ungulate ranges in western and northern Alberta, wolf populations may be temporarily reduced to assist ungulate restoration and enhancement.

2. Public awareness and appreciation of the wolf in Alberta will be encouraged.

3. Recreational hunting of wolves will be promoted in western and northern Alberta, north of the Bow River, through education, long seasons, and the use of baits and electronic calls. Hunting of wolves by non-residents will be promoted.

4. Education and incentives will be provided to trappers to encourage an annual provincial fur harvest of about 900 wolves. Where wolf predation is scientifically identified as a major limitation to ungulate populations, assistance will be provided to trappers to increase their wolf harvest.

5. Where trapper assistance fails to address identified ungulate predation problems, regional operational plans will establish ungulate population objectives, the wolf-ungulate relationship, and strategies for ungulate restoration including wolf control. The plans that include wolf reductions will be submitted to full public review.

6. Preventive livestock management, planned land management, the Alberta Livestock Predator Compensation Program, liberal shooting regulations on private land and removal of offending wolves will be implemented to minimize property damage and other hazards of wolves.

1.0 INTRODUCTION

Few species of wildlife engender as strong emotions in humans as does the gray wolf (Canis lupus). Once widely persecuted throughout most of its extensive range in the northern hemisphere because of its predacious habits of killing livestock and game, it has in more recent times become recognized as a valued inhabitant of the wilderness. There are demands for opportunities to observe wolves as they hunt their prey in settings reminiscent of the past and for the wolf to survive as a component of well-ordered natural systems. There are organizations dedicated to wolf preservation in wilderness range.

Nevertheless, problems continue to arise regarding wolves as predators. Agriculturists desire protection or compensation for livestock losses. Requests for government assistance vary with land ownership and personal philosophies. Game managers and hunters strive to find answers to declining ungulate populations in the face of high levels of natural predation in changing habitats. Some trappers attempt to harvest wolves for the pelts but have difficulty in doing so.

The wolf has been the subject of intensive scientific study. Much of the research has been directed toward an understanding of its role as a predator of hoofed mammals (ungulates). As a result of recent studies, scientific opinion has changed on the regulatory effect of wolf predation. It is now understood that wolf predation may be the major source of mortality on some ungulate populations and that under a variety of environmental circumstances, including natural and man-made influences, predation may result in declining populations.

Bitter debate over governmental plans to control wolf populations

has erupted in Alaska, the Yukon and British Columbia in recent years; Alberta has had its share of controversy, too. There is a great need for more understanding of wolf ecology and relationships by the general public and more diversified, practical management. This management plan details the history of wolf populations and wolf management in Alberta. It summarizes current uses, and recommends goals, objectives, strategies and actions to ensure wise use and management of wolves in the years to come.

2.0 BACKGROUND TO THE PLAN

2.1 History

2.1.1 Historical Populations

Explorers and fur traders noted an abundance of wolves in the area that eventually became Alberta. In 1754 Anthony Henday, Alberta's first European explorer, reported wolves as common as bison (Bison bison), which occurred in the many thousands throughout the Canadian plains (Burpee 1907). David Thompson observed wolves in the Athabasca Valley [now Jasper National Park (JNP)] in 1810 (Carbyn 1974a) and Alexander Henry observed wolves in the foothills west of Rocky Mountain House in 1811 (Coues 1897). The Palliser expedition of 1857-60 (Spry 1963) reported wolves were plentiful throughout the prairies and foothills, noted exceptional abundance of wolves in the Battle River area, and recorded Native reports of occasional rabies epizootic episodes in wolves. McDougall (1898) reported wolves were numerous around bison hunting camps in 1865, and were known to kill Native horses. Wolves were abundant in the prairie and foothill habitats, until at least the 1870s, because of the diversity and abundance of prey species. They also occurred in the mountains and northern forests, but probably at lower densities than in the former habitats.

During the 1860s and 1870s, bison herds were systematically slaughtered for their hides and meat. Other native ungulates were greatly reduced as a result of European settlement and cultivation, the supplying of mining camps and towns by hunters, and very severe winter weather. During that period, wolves were poisoned for their pelts and in

retaliation for their raids on meat caches. "Wolfing"--strychnine poisoning of wolves on bison carcasses--became an easy and lucrative means of taking wolves (Rodney 1969). Cattle were driven north from the western United States during the 1870s and 1880s and, consequently, wolf predation on cattle was recorded as early as the late 1870s (Rodney 1969) and in 1885 in the foothills region where wolves remained more common (McCowan 1950). By 1890 the bison were virtually eliminated, cattle were common, and wolves were much reduced in numbers in the prairie portion of "Alberta." A wolf bounty, administered by the Western Stock Growers' Association, was established in 1899 [Dep. Agric. (Alberta) Ann. Reps. 1905, 1907; Pimlott 1961].

Stelfox (1969) estimated that wolves were very scarce along the eastern slopes of the Rockies and practically nonexistent in the prairies and parklands of the central portion of the province by 1900, although Williams (1946) reported two wolves with young and others near Milk River in extreme southern Alberta during 1923-25. Stelfox further noted observations of declining wolf abundance in northern Alberta between 1900 and 1930. This decline in numbers of wolves in the western and northern boreal forests was related to three major factors: 1) the use of strychnine during winter months by trappers of that period, 2) conventional trapping and shooting, and 3) the reduced numbers of large ungulates (Millar 1916; Cowan 1947).

Soper (1964) reported wolves in Wood Buffalo National Park (WBNP) in 1925 and a southwesterly [and perhaps easterly from British Columbia (Stelfox 1969)] expansion of range and numbers occurred throughout the 1930s and 1940s. Wolves were reported south of Grande Prairie by the mid-1930s (Stelfox 1969), were common north of the Athabasca River by

1939 (Soper 1964), and occupied the vicinity of JNP in the 1930s (Clarke 1942; Stelfox 1969). Farther south, wolves reached the vicinity of Banff National Park (BNP) in 1943 (Rowan 1950; Green 1951) and lone individuals reappeared in Waterton Lakes National Park (WLNP), in the extreme southwestern corner of the province, in 1943 following extermination there in 1922 because of livestock depredations (Cowan 1947).

The dramatic increase in range and numbers of wolves in Alberta during the 1930s and '40s resulted from the return to abundance of big game animals, low market value of wolf pelts to trappers and removal of the wolf bounty in 1931 (Clark 1933). In 1944, Natives and "whites" in the Peace River-Grande Prairie area of northwestern Alberta reported abundant wolves still on the increase and severe predation on livestock and game animals (Soper 1948).

During the 1940s, game managers became progressively more concerned about the effects of wolves on big game. By 1945, the Fish and Game Commissioner conceded that wolves were reducing numbers of deer (Odocoileus spp.) and moose (Alces alces) and, in succeeding annual reports, this concern with predation was repeated (for a more detailed review, see Gunson 1984).

Attempts were made to determine the best methods of reducing wolf populations. The use of poisons was ruled out following consultation with authorities in the USA. In 1945, neck snares were allowed on registered traplines, although apparently few wolves were taken in this way. By 1950, cyanide-ejecting "coyote getters" were distributed to field staff (550 getters to 90 men) to reduce numbers of coyotes and wolves in forested areas (Huestis 1951). Huestis (1953:54), the Fish and Game Commissioner, reported that wolves and coyotes remained a problem in

1952-53 and that "necessary ammunition, poison, snares and traps" were supplied for control.

During the 1940s and 1950s wolves were reduced in JNP as part of the management of ungulates and to help control rabies (Cowan 1947; Carbyn 1974a). Numbers were also reduced in WBNP in 1941-42, 1948-49, 1951-52 (Fuller and Novakowski 1955) and the reductions continued for the years 1952-53, 1953-54, 1957-58, and 1959-60 (L. Carbyn, pers. comm.).

In June 1952, rabies was reported in red fox (Vulpes vulpes) in northeastern Alberta; the infection spread from a high-density fox population in adjacent Northwest Territories. By February 1953, the disease had spread to coyotes (Canis latrans) in southern Alberta and to many other wild and domestic species (Ballantyne and O'Donoghue 1954). One wolf was laboratory-diagnosed as rabid and several other rabid wolves harassed residents and transmitted the disease to swine and cattle in the Fort Vermilion area of northwestern Alberta (Ballantyne 1957).

Traplines to control carnivores were established in areas along the agricultural land-forest fringe and in the vicinity of some northern communities. A population reduction zone, consisting of a line of two traplines in width and 8000 km (5000 mi.) in length and employing 170 trappers, was established on forest edges surrounding settled areas (Huestis 1953). Control methods included snaring, trapping and den eradication, but most wolves were removed by poisoning.

The estimated kill of wolves by February 1956 was 5461 (Ballantyne 1958). Because the estimate was based on a correction of three to four undiscovered dead wolves for every dead wolf at baits, it was, in all probability, exaggerated (Gunson 1984). Stelfox (1969) estimated 90 percent of the kill was in northwestern Alberta. He

considered the provincial population in 1952 to be 5000 and during the postcontrol period of 1956-60 to be between 500 and 1000 wolves (see Stelfox 1956, 1964, 1965a, 1965b, 1966).

Whereas wolf control from 1952 to 1956 was primarily intended to reduce populations of rabies vectors, control during 1957-66 continued for reasons related to ungulate management, although at reduced levels. On provincial lands, attempts were made to integrate wolf control with big game numbers, range conditions, hunter harvest and wolf populations (Stelfox 1958). Pack territories and estimated numbers of wolves were reported and wolf control was recommended for certain areas (Stelfox 1964, 1965b). Wolf control in national parks in Alberta ceased in 1959 (Carbyn 1974a).

Wolves increased in distribution and numbers throughout the 1960s. In 1965, Stelfox (1965b:1) summarized wolf demographics as "The current predator situation is one of a generally expanding wolf population." He estimated a provincial total of 3550 wolves by 1965-66 (Stelfox 1969). In 1966, wolves occupied permanent territories south at least to the Bow River west of Calgary, while lone individuals occurred as far south as Pincher Creek and near WLNP (Stelfox 1969). Wolf control for big game management was phased out in 1966, but occasional control continued in response to livestock depredations.

By 1970, wolf packs ranged farther south to at least the Highwood River drainage and two lone wolves were shot near the Cypress Hills in the southeastern corner of the province in 1971 and 1972. By 1972, wolf-livestock depredation complaints had become more common and annual control was initiated at problem sites (Gunson 1973).

Wolf populations reached greatest size in recent times in Alberta

during the early to mid-1970s. The provincial population may have exceeded 5000 for several years; Lynch (1973) calculated a potential provincial population of 8417 wolves based on densities observed in comparable habitats elsewhere. Fur harvest peaked at 880 pelts in 1972-73. Sarcoptic mange, an ectoparasite infection associated with high numbers of wolves, was most common in 1974-75 (Todd et al. 1981). The greatest number of wolves (144) taken in annual control programs in livestock areas was reached in 1975-76.

By the mid-1970s, most of the available range in northern and western Alberta was occupied by wolves, and reoccupation of small, forested areas near settlements occurred soon after (Gunson 1983a). For example, a population of about 25 wolves occupied the area of the Beaver River Metis Settlement north of Smoky Lake, an area that had been without wolves for many years. Livestock depredations were soon occurring annually and many of the wolves responsible were removed during the early 1980s (B. Rippin, AF&W manager, pers. comm.).

Similarly, at least 7-10 wolves occurred in the Oldman River-Livingstone Range area of southwestern Alberta during the mid-1970s (Mattson and Ream 1980; Harris 1981) and livestock depredations occurred there in 1976. Six wolves were taken at a poison station that winter (Cole et al. 1977). Harris (1981) listed 65 reports of wolves in southwestern Alberta during 1977-81, and at least five wolves were shot.

During the 1980s, numbers of wolves in Alberta probably declined from the population levels of the early to mid-1970s, because of declines in abundance of major prey species (Fuller and Keith 1980; Gunson 1984; G. Lynch unpubl.; Schmidt and Gunson 1985; Edmonds 1986).

In Figure 1, the wolf-moose relationship over the period from 1920 to 1980 (adapted from Gunson 1984; Lynch unpubl.) illustrates significant changes in population numbers. Subsequently, widespread mortality of moose occurred during the relatively severe winter of 1981-82 in northern Alberta (Rippin 1983; Drew 1984). In 1982, wolves were reported to wildlife officers more frequently than in previous years (Gunson 1983b). Complaints of too many wolves, primarily by agriculturists and hunters, led to public controversy in Alberta and adjacent provinces and territories.

In response to the discussion in Alberta, provisional wolf management strategies were outlined by government in January 1983. These included special trapper education and incentives, promotion of an annual wolf harvest by trappers of 30 percent of the provincial population and reduction of wolves in critical big game ranges. Reviews of wolf-ungulate predation in North America (Gunson 1983c) and wolf-big game management in Alberta (Gunson 1984) were completed.

2.1.2 Highlights of Historical Wolf Management in Alberta

1899 .... Ordinances of the NWT established a bounty on timber wolves to be paid through livestock associations. The Western Stock Growers' Association administered payments until 1907 in southern Alberta.

1905 .... Payments were $15 per adult wolf and $5 per pup. "Regulations for the issue and payment of Warrants for the Destruction of Wolves by the Provincial Stock Associations" were appended to the 1905 Annual Report of the Department of Agriculture.

1907 .... The provincial legislature adopted by Order in Council "Wolf Bounty Regulations" providing for payment of a bounty on wolves and coyotes throughout the province. Payments through the Western Stock Growers' Association were cancelled.

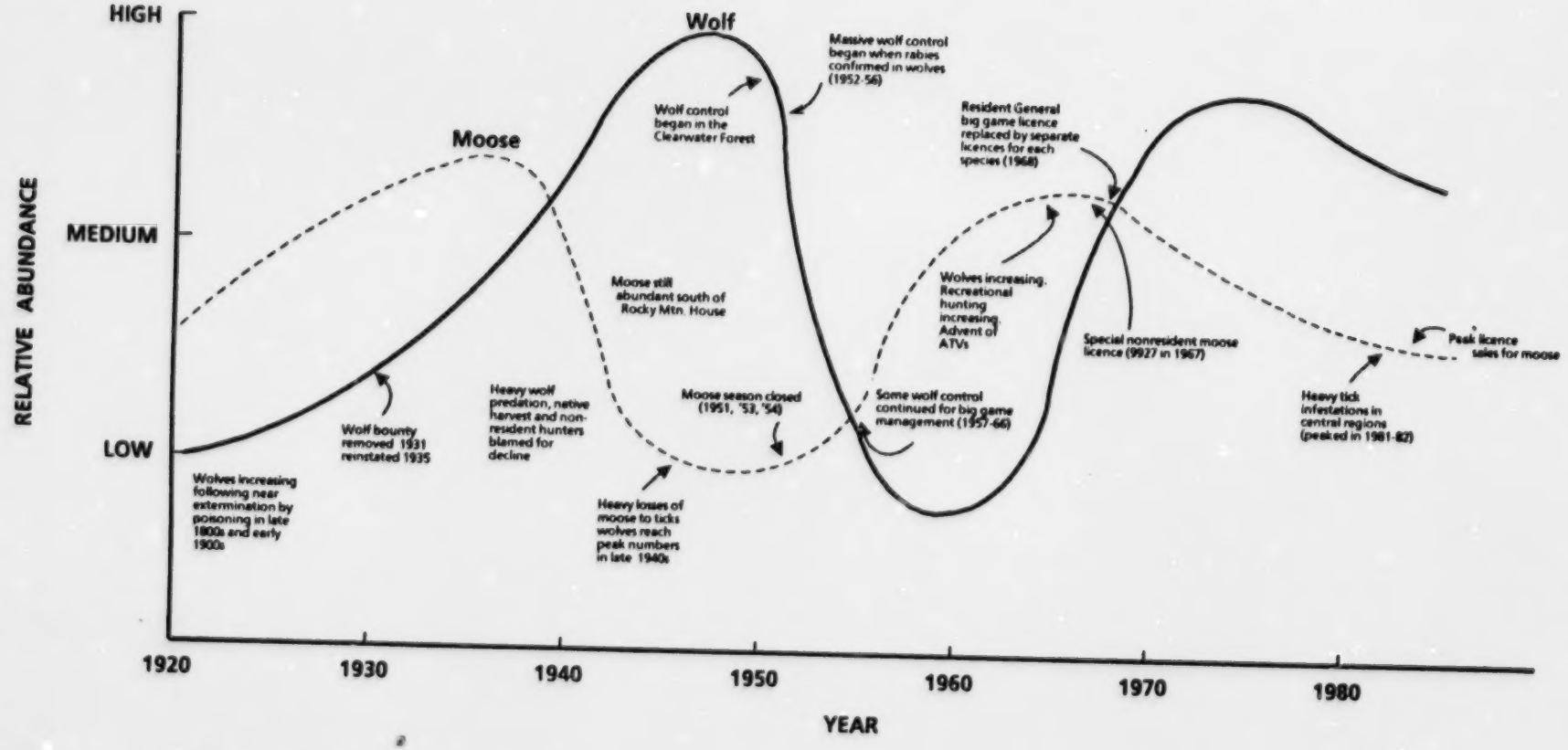
HIGH
MEDIUM
LOW
RELATIVE ABUNDANCE
Wolf
Moose
Massive wolf control began when rabies confirmed in wolves (1952-56)
Wolf control began in the Clearwater Forest
Resident General big game licence replaced by separate licences for each species (1968)
Moose still abundant south of Rocky Mtn. House
Wolves increasing. Recreational hunting increasing. Advent of ATVs
Special nonresident moose licence (9927 in 1967)
Peak licence sales for moose
Heavy tick infestations in central regions (peaked in 1981-82)
Heavy wolf predation, native harvest and non-resident hunters blamed for decline
Moose season closed (1951, '53, '54)
Some wolf control continued for big game management (1957-66)
Wolf bounty removed 1931 reinstated 1935
Wolves increasing following near extermination by poisoning in late 1800s and early 1900s
Heavy losses of moose to ticks wolves reach peak numbers in late 1940s
1920
1930
1940
1950
1960
1970
1980
YEAR

Figure 1. **Changes in relative abundance of moose and wolves in Alberta with associated limiting and growth factors (adapted from Gunson 1984 ; G. Lynch unpubl.).**

Wolf bounty inspectors were appointed under the new regulations. Advice on trapping and poisoning of wolves was provided in the Department of Agriculture Annual Report.

1909 .... "An Act for the Payment of Wolf Bounty" was assented to in the provincial legislature providing for the payments of $10 per timber wolf, $1 per coyote ("prairie wolf"), and $1 per wolf pup.

1917 .... The Wolf Bounty Act was amended to increase the payment for female timber wolves from $10 to $20; males remained at $10.

1927 .... Bounty on pups was increased to $2.

1931 .... Payment of wolf bounties was discontinued by Order in Council.

1935 .... Wolf bounty was reinstated.

1937 .... Payments were $5 for adults and $2 for pups.

1938 .... Bounty payments were increased to $10 for adult wolves and $5 for pups.

1942 .... Special snaring permits were issued to certain trappers to assist in wolf capture.

1943 .... Payments were $10 for any wolf.

1945 .... Use of neck snares was allowed on registered traplines throughout the province.

1946 .... Bounty payments were increased to $25 per wolf during 1 Apr. - 15 Oct.

1947-53.. Payments were $15 for each wolf taken from 1 Apr. - 30 Sept. and $12, from 1 Oct. - 31 Mar.

1950 .... Cyanide-ejecting "coyote getters" were distributed to field staff to reduce numbers of wolves and coyotes in forested areas.

1951 .... The Game Commission agreed to wolf control for big game management in the Clearwater Forest with the use of strychnine baits.

1952-56.. Predator management for rabies control removed several thousand wolves, mostly by poisoning.

1954 .... Canadian Predator Control Conference in Calgary recommended abandonment of bounties. Wolf bounty was discontinued in Alberta in 1954-55.

1964 .... Wolves were classed as "fur-bearing carnivores." This provided landowners the continued right to shoot them on private lands throughout the year and without a licence, while, on public lands, shooting was allowed only during 1 Sept. - 31 Mar. under the authority of a valid Big Game Licence.

1966 .... An estimated 76-86 wolves were removed for enhancement of ungulate populations during winter 1965-66 - the final year of such wolf control in Alberta.

1967 .... The first regulated trapping season for wolves (1 Sept. - 30 Apr.) was established.

1972 .... The recreational hunting season for wolves was extended to 31 May.

1974 .... The Livestock Predator Compensation Program was initiated.

1975 .... A nonresident wolf licence was introduced.

1981 .... The licence requirement for residents to shoot wolves on public lands was changed from a valid Big Game Licence to a Wildlife Certificate only.

1984 .... The rights of landowners, grazing lessees or their designates to shoot wolves were extended to include any land within 8 km of the private or leased land.

1986 .... The Fish and Wildlife Division gave serious consideration to wolf reductions in west-central Alberta to restore populations of woodland caribou and elk.

1987 .... All requirements for wolf hunting licence were dropped for residents.

2.2 Biology

2.2.1 Taxonomy

Goldman (1944: 404) pointed out that gray wolves "... are all very similar in the more essential features and are believed to integrate through the vast range of the species on the North American mainland." Goldman (1944) and Hall and Kelson (1959) listed five subspecies of

wolves as occurring in Alberta in historic times: in the boreal northwest - C. l. occidentalis, the boreal northeast - C. l. griseoalbus, the mountainous west - C. l. columbianus, the foothills and mountains of the south - C. l. irremotus, and the prairie southeast - C. l. nubilus. Jolicoeur (1959), Nowak (1983) and others have questioned this degree of subspeciation in western Canada. The extensive reductions of wolves in Alberta, noted earlier herein, would very probably have altered subpopulation differences, mostly to the advantage of more northern types. Two types found in southern Alberta, irremotus and nubilus, probably have been eliminated.

2.2.2 Distribution

The wolf has adapted to a wide range of habitats including arctic tundra, taiga, plains and a variety of forest types. With the exception of vast deserts and high mountaintops, the species at one time ranged throughout most of North America, Europe and Asia. In North America, the wolf's range may have been greater than any other terrestrial mammal, extending southward to include most of present-day Mexico and north to northeastern Greenland (Mech 1970). The wolf still occupies more than 90 percent of its original range in Canada (Banfield 1974; Nowak 1983).

In Alberta, the wolf successfully repopulated most of the forested areas in western and northern portions of the province during the 1960s and 1970s (Gunson 1983a). Although southerly expansion of range along the western mountains and foothills south of the Bow River slowed during 1977-81 [partly because of wolf control associated with livestock depredations (Harris 1981)], recent observations of wolves in

WLNP and northwestern Montana suggest a gradual buildup has recurred in the vicinity of the international border.

2.2.3 Description

The wolf is the largest wild member of the dog family, Canidae. In Alberta, during winter, adult males average 48 kg (106 lb.) and adult females, 41 kg (91 lb.). As indicated in the tabular data below, growth of young wolves in Alberta is rapid with approximately 96 percent of length and 79 percent of weight achieved during the first year of life [data from problem wolves autopsied during 1972-79 (J. Gunson unpubl.)].

	Female				Male			
	Whole Weight (kg)		Length (cm)		Whole Weight (kg)		Length (cm)	
Pups	33 ±6*	(47)**	161 ±9	(77)	37 ±7	(48)	167 ±14	(70)
Yearlings	39 ±5	(30)	165 ±8	(47)	47 ±5	(34)	173 ±10	(47)
Adults	41 ±4	(91)	166 ±9	(119)	48 ±6	(78)	175 ±8	(99)

* = SD
** = N

Alberta wolves are large; 40 to 45 percent heavier, on the average, than in the Great Lakes region (Fuller and Keith 1980). Many of the largest skulls of measured, North American gray wolves are Alberta specimens (Gunson and Nowak 1979; Gunson 1986a). Location and year of collection of the eight largest Alberta wolves are listed below.

Rank	Location	Year	SKULL MEASUREMENTS	
			Greatest Length (mm)	Zygomatic Width (mm)
1	Roche Lake	1966	304.5	154.8
2	Rio Grande	1973	297.6	158.0
3	Shiningbank Ridge	1986	297.4	155.5
4	Athabasca	1974	288.8	162.5
5	Simonette River	1983	289.4	159.5
6	Pinto Creek	1973	292.6	155.8
7	Rock Island Lake	1979	292.7	155.0
8	Water Valley	1973	285.3	160.4

Gray is the predominant colour of wolves in Alberta. Of 498 "problem" wolves captured and examined by the Fish and Wildlife Division during 1972-79, 68 percent were gray. Black phases occur commonly (31% in the Alberta specimens). White specimens occur rarely in Alberta (1%). Dekker (1986) noted disproportionately more black wolves (52% of 269 sightings) in JNP. Colour proportions for wolves in other areas resemble the Alberta data: northern BC (N = 481, black = 33%) and Kenai, Alaska (N = 254, black = 32%) (from Dekker 1986).

The wolf is well constructed for a life of travel and predation. Its long legs and deep, narrow chest are adaptations to fast and far-ranging travels (Mech 1970). Wolves have keen senses of smell and hearing and can detect wolf howls from 10 km away (Harrington and Mech 1979). Their vision, at least for detecting movement, is sharp (Mech 1970). Morphological and behavioral evidence of a reliance on large mammals for the major portion of the diet of the wolf are their large size, massive teeth, the ability to digest great quantities of food in short periods (e.g., Gunson 1986b) and the habit of travelling in packs

over great distances.

2.2.4 Social Organization, Reproduction and Mortality

The basic unit of wolf populations is the pack--a cohesive group of two or more individual wolves that travel, hunt and rest together throughout the year. The number of wolves in a pack varies from two to reported highs in excess of 30 (Rausch 1967; R. Hayes, Yukon Wildl., pers. comm.). Packs average 5 to 8 members, although packs of 9 to 12 wolves are commonly reported, and even larger packs occur.

The proportion of lone wolves in established wolf populations is typically less than 15 percent (Mech 1970; Peterson 1977; Fuller and Keith 1980; Bjorge and Gunson 1983). Lone wolves are the consequence of subadult dispersal or the ejection of inferior individuals from a pack.

There may be a positive relationship between pack size and the size of principal prey species. For example, wolves preying on white-tailed deer are commonly organized into packs of 2-9 (Pimlott et al. 1969; Mech 1973) compared to 6-22 on moose (Peterson 1977; Fuller and Keith 1980). Social strife can lead to permanent splitting of large (>10 wolves) packs (Wolfe and Allen 1973; Peterson 1977). Packs may temporarily split up for hunting purposes in either winter or summer (Mech 1970; Schmidt and Gunson 1985). Most packs include a pair of breeding adults, pups, and often yearlings and/or extra adults (Murie 1944; Fuller and Novakowski 1955; Rausch 1967).

The breeding season for wolves occurs from late January through April, with wolves in the highest latitudes generally having the latest season (Mech 1970). In Alberta, most breeding occurs in late February

through March with an average of five pups (usual range four to seven) born during late April through May. In Yellowstone National Park, USA, litters of 10 and 11 were found following several years of exploitation (Weaver 1978). Although female wolves in captivity have bred successfully at 10 months of age (Medjo and Mech 1976), wild wolves typically do not breed until 22 months (Mech 1970).

Mortality of wolf pups from birth to midwinter of their first year ranges up to 80 percent with rates around 50 percent being common (Rausch 1967; Pimlott et al. 1969; Mech 1977a; Fritts and Mech 1981). Survival of pups in Minnesota was related to body size and their food supply (Van Ballenberghe and Mech 1975). These latter investigators concluded that pups less than approximately 65 percent of standard weight had a low chance of survival.

In Alberta, wolves over seven or eight years of age are rare (J. Gunson unpubl.). Wild wolves do not often live as long as other large carnivores (e.g., bears) because of their more predacious life style. Injuries and death occur as a result of the defensive actions of their larger prey. Mortality rates in excess of 30 percent of fall populations may lead to population decline (Keith 1983).

2.2.5 Population Dynamics

Wolves typically occur at densities of 1 wolf/80 km^2 to 1 wolf/150 km^2. A concept of "intrinsic limitation," that wolf populations reach saturation at a density of 1 wolf/26 km^2 (1 wolf/10 sq.mi.), was previously generally accepted (Pimlott 1967). More recent studies (Van Ballenberghe et al. 1975; Peterson 1977) revealed wolf densities reaching

1 wolf/12 km^2 (1 wolf/5 sq.mi.), which suggested to Packard and Mech (1980) that both social and nutritional factors operate in the regulation of wolf numbers. Keith (1983) suggested wolf densities adjust to available food resources, with rates of increase declining to zero as "per capita" food supplies declined. Messier (1987) related small pack size, slower growth of pups and underweight adult wolves to low moose density.

Sex ratios of several populations in North America and Eurasia were biased toward males (Mech 1970). Mech (1975) found proportionally more male pups in denser populations in Minnesota; this ratio may have been inversely related to estimated levels of nutrition. Pup:adult ratios were generally greater in exploited populations (Fuller 1954; Fuller and Novakowski 1955; Rausch 1967; Kelsall 1968; Pimlott et al. 1969).

2.2.6 Dispersal, Movements and Territories

The nature, extent and role of dispersal in wolf populations appear related to wolf density and prey resources (Zimen 1976; Packard and Mech 1980; Fritts and Mech 1981). Wolves disperse at ages ranging from 9 to 28 months or more (Packard and Mech 1980). Dispersal in the fall by yearlings is common. Occasionally, dispersals are very long [e.g., 886 km from near International Falls, Minnesota to the vicinity of Carrot River, Saskatchewan (Fritts 1983) and 670 km from NWT to central Alberta (Van Camp and Gluckie 1979)].

In most wolf populations, reproductive packs occupy exclusive territories, while nonbreeding loners either live in buffer zones between

packs or live in association with but avoid packs (Mech 1973; Peterson 1977; Fritts and Mech 1981; Bjorge and Gunson 1983). Wolf territories function as a means of partitioning prey resources in those areas where prey are more or less randomly distributed and do not undergo major seasonal migrations. This spacing is maintained both by aggressive encounters and by advertisement of a pack's presence through scent marking (Peters 1973; Peters and Mech 1975) and howling (Harrington and Mech 1979).

Territories have ranged in size from 52 km^2 for a pack of five in Minnesota (Van Ballenberghe 1975) to 2455 km^2 for a pack of 14 in western Alberta (Schmidt and Gunson 1985). Reported sizes of many territories fall in the range of 125 km^2-500 km^2 (Mech 1970; Peterson 1977). Home ranges for large wolf packs in Alaska, dependent on migratory prey, were much larger than the preceding (Burkholder 1959; Haber 1977). Lone wolves typically have large ranges and may overlap two or three pack territories.

Generally packs have larger territories in winter than in summer (Mech 1970, 1977b), which has also been observed in Alberta (Bjorge and Gunson 1983; Gunson et al. in prep.). During spring and early summer, a reproductive pack's movements are centered around den and rendezvous sites (rearing areas). By late summer, pups are mature enough to travel and, consequently, pack movements are greater. Daily distances travelled are greater in winter than in summer.

2.2.7 Predation

2.2.7.1 Food Habits

Wolves depend primarily on ungulates for food, especially during winter (Mech 1970; Pimlott 1975). In Alberta, ungulate prey include moose, white-tailed deer (Odocoileus virginianus), mule deer (Odocoileus hemionus), elk (Cervus elaphus), caribou (Rangifer tarandus), bison, bighorn sheep (Ovis canadensis), feral horses, and occasionally mountain goat (Oreamnos americanus) as well as several domesticated species. Where beaver (Castor canadensis) occur, they are hunted during the ice-free season. On a biomass basis, ungulates contribute the bulk of summer diet as well as virtually all of the winter diet of most wolves (Floyd et al. 1978; Peterson et al. 1984).

2.2.7.2 Predation and Consumption Rates

The frequency with which wolves kill ungulate prey has been determined in several intensive study areas in North America by aerial observation, radiolocation, or tracking wolves during winter when kills are more easily discovered. Kill rates of wolves are importantly influenced by pack size, and abundance and size of prey species. Where moose are the predominant prey, kill rates are 22-24 kills/wolf/1000 days (Fuller and Keith 1980; Peterson et al. 1984; Peterson 1985) or one kill/pack every 4.7 - 5.4 days.

Where prey are smaller than moose, kills occur more frequently as in the Brazeau-Blackstone rivers area of Alberta where 9-11 wolves of one pack made a kill (comprising elk, moose, mule deer, bighorn sheep or feral horse) every 2.6 days during winters 1983-84 and 1984-85 (Schmidt and Gunson 1985). In Ontario, where the average pack size was eight

wolves (Kolenosky 1972) and deer were the principal prey of wolves, kills occurred every 2.2 days.

Kills are more difficult to locate during summer months and most estimates of predation for the snow-free period result from scat analyses. Peterson et al. (1984) calculated that moose represented 77 to 97 percent of dietary biomass during summer in several study areas where moose were the principal prey. They calculated a mean of 3.9 calf moose killed for every adult moose during summer in the same areas. In the Yukon, moose calves were a major component of the summer diet of wolves (R. Hayes pers. comm.).

2.2.7.3 Prey Selection

Wolves are opportunistic predators; thus, selection often occurs for smaller prey over larger and for both young of the year and old individuals over those in the prime of life (Fuller 1962; Mech 1970; Carbyn 1974b). Selection of calves and fawns by wolves during summer has been widely reported (Pimlott et al. 1969; Peterson 1977). Wolves also select for vulnerable individuals. Vulnerability is influenced by several factors including age and sex, condition related to nutrition and disease, behavior and snow conditions. Beaver may contribute substantially to the summer diet of wolves (Voigt et al. 1976; Peterson 1977) and are the only non-ungulate of significance in the wolf's diet in most areas. Prey smaller than beaver are opportunistically consumed, but rarely form a substantial portion of the annual biomass in the diet of wolves.

2.2.7.4 Effect of Wolf Predation on Prey Populations

The effect of wolf predation on prey populations has been the source of much scientific debate and public controversy and emotion. Recent studies indicate the following:

a. the absence of effective self-regulating mechanisms among cervids in North America is good evidence such populations faced significant predation before modern times (Pimlott 1967);

b. carnivore predation of ungulate calves can be as high as 80 to 90 percent of recruitment (Bergerud 1980; Larsen and Gauthier 1985);

c. wolf predation is a major component of total annual mortality in many ungulate populations, and wolf predation of ungulates is largely additive to other mortalities (Keith 1974, 1983); and

d. wolf predation is a significant controlling factor and may at times be regulatory (Mech and Karns 1977; Keith 1983; Farnell and McDonald 1987; Hatter 1988; Gunson et al. in prep.).

Special circumstances often accentuate the impact of wolf predation. These include decreasing quality and quantity of prey forage, severe winters, availability of alternate prey and effects of recreational hunting. Wolf predation can sustain ungulate declines initiated by other single or combined factors (Gasaway et al. 1983). Predation, often by wolves, may become the proximate limitation during periods of low ungulate abundance following declines caused by a combination of limitations.

Reduction of wolves to enhance low ungulate populations have generally succeeded. In southwestern Quebec, moose calf survival in a wolf removal block exceeded survival in the control area during 2 of 4 years (Crete and Jolicoeur 1987). In an adjacent block where black bears were reduced, moose calf survival was significantly higher than in the control area during 2 of 3 winters. In northern British Columbia, woodland caribou increased at an average of 6 percent per year (N=5 yrs)

following wolf reductions (Bergerud and Elliott 1986). Following a 61 percent reduction in the wolf population in interior Alaska, survival of caribou and moose calves increased and these populations increased (Gasaway et al. 1983). In south-central Alaska, reduced wolf densities improved the survival rate of calf moose, but most predation of moose calves was by brown bears (Ballard et al. 1987). Survival of calf and adult caribou increased, in the Yukon after wolves and hunters' harvests were reduced (Farnell and McDonald 1987). Advantages and disadvantages of several methods of wolf control are as follows:

Method	Public Tolerance	Advantages/Disadvantages	Source(s)
Trapper Incentives	High to Moderate	Well accepted by trappers. Often ineffective. Costs variable.	Olsen and Epp 1987, Atkinson and Janz 1986, Janz and Hatter 1986
Government Trapper	Moderate	Effective in localized areas. Cost - $600-$800/wolf.	D. Janz, pers. comm.
Toxicants	Moderate to Low	Some nontarget kill. Effective. Cost - $200-$300/wolf.	Bjorge and Gunson 1985
Aerial Shooting	Low	Selective. Effective in semi-treed habitats only. Cost - $300-$500/wolf.	R. Farnell, Yukon Wildl. Branch and J. Elliott, BC Wildl. Br. pers. comm.

2.2.7.5 Predation of Livestock

In areas of Eurasia and North America, wolves have preyed on livestock where their ranges overlap. Reaction to this predation resulted in virtual extermination of wolves in most of the USA south of 49°N during agricultural settlement. Despite the importance of this predation to livestock producers and wolves, little scientific research was carried out until the 1970s. General assessments of wolf-livestock

relationships have been made in British Columbia (Tompa 1983), western Canada (Gunson 1983d) and Minnesota (Fritts 1982) (see Weaver 1983, 1986 for general reviews). More intensive investigations occurrred in north-western Alberta (Bjorge and Gunson 1983, 1985) and Beltrami Island State Forest (BISF), Minnesota (Fritts and Mech 1981).

This research has revealed that many wolves living near livestock areas do not prey on livestock. For example in BISF, only several instances of predation of livestock by wolves of five instrumented packs was confirmed or suspected during a five-year period. Nevertheless, wolf predation of livestock can be important to individual producers and removal of wolves can reduce losses.

2.2.8 Significance of Wolf Diseases

Certain diseases and parasites of wolves may lead to wolf mortality or to disease in other species. Among those identified in Alberta are sarcoptic mange (Sarcoptes scabiei), trichinosis (Trichinella sp.), oral papillomatosis, rabies and several species of cestodes (Echinococcus granulosus, Taenia krabbei, T. hydatigena, T. pisiformis, Toxascaris leonina) (Holmes and Podesta 1968; Samuel et al. 1978; Gunson and Dies 1980; Todd et al. 1981). Antibodies to canine parvovirus (CPV) have been found in wolf sera and scats collected in the Nordegg area of Alberta (J. Gunson, unpubl.). The most important of these diseases are mange, hydatid disease (Echinococcus granulosus), trichinosis and potentially rabies.

Mange in wolves is a condition of skin lesions and crusting, and hair loss caused by a burrowing mite, which together may lead to death,

especially during severe winter weather (Samuel 1973; Samuel 1981). Mange has probably occurred in wolves for a long time (Pike 1892), was first reported in wolves in Alberta in 1946 (Green 1951) and has manifested itself primarily during periods of high wolf numbers (Todd et al. 1981). The disease was observed in wolves in Alberta during most winters from 1970-71 to 1977-78, and was most prevalent during 1974-75 (Todd et al. 1981). Pups (<1 year) constituted 41-47 percent of wolves killed at poison-bait stations when mange was least prevalent, but only 16-22 percent when mange was most prevalent suggesting mortality from mange may be greater in pups than older wolves.

The larval form of sylvatic E. granulosus occurs in wild ungulates and the adult tapeworm occurs in wolves, coyotes and dogs. Seventy-two percent of 98 wolves were infected with E. g. during 1959-67 (Holmes and Podesta 1968). Hydatid cysts occur in moose, caribou and elk and less commonly in deer, but usually have no detectable ill effect on these wild cervids (Wobeser 1985). However, very heavy infections in the lungs or cysts in locations such as the brain could cause debilitation. The primary importance of this parasite is related to human infection. Humans may become infected through exposure to eggs in canid droppings. Biologists or others working with scats of wild canids should take special precautions to prevent contamination. Cysts in the tissue of the intermediate host (wild cervids) are not infectious to humans.

Trichinosis is caused by infection with Trichinella sp. Larvae of this nematode were recovered from 12 of 217 wolves collected in Alberta during 1975-78; all infected wolves occurred in northern regions (Gunson and Dies 1980). If humans develop moderate or heavy infections, disease may be severe, so the meat of carnivores should be considered

potentially infected and cooked thoroughly before consumption. Clinical disease resulting from Trichinella infection has not been observed in wolves, but may occur.

Rabies is a viral disease usually transmitted by the bite of a mammal. In Alberta, the disease is most common in bats and striped skunks (Mephitis mephitis). Infection often leads to abnormal behaviour, paralysis and death. One wolf was diagnosed as rabid and several other rabid wolves harassed residents and transmitted virus to swine and cattle in the Fort Vermilion region of northern Alberta during 1952-53 (Ballantyne 1957).

2.3 Status

2.3.1 Supply

2.3.1.1 Distribution and Numbers

Wolves currently occupy approximately 399 000 km^2 of range in Alberta or 60 percent of the province (Figure 2). This includes about 339 000 km^2 of unsettled Green Area, 53 000 km^2 of national parks and 7000 km^2 of vacant public lands within the White Area (Public Lands General Classification Map, April 1986).

Calculated or estimated densities during winter in six areas ranged from 1 wolf/40 km^2 to 1 wolf/225 km^2 (Table 1). Numbers of wolves in all areas except Jasper National Park were determined with the use of radiotelemetric monitoring. The provincial population was estimated using data from intensive studies at AOSERP, Simonette River, Swan Hills, Nordegg, and WBNP. This estimate was based on the following: observed average territory size of 21 packs (919 km^2), average pack size of 8.7

Table 1. Densities of wolves during winter in Alberta.

Area	Years	Number of Wolves	Density (km^2/wolf)	Source
Jasper National Park	1942-46	38- 48	225-286	Cowan 1947
	1969-70	48	225	Carbyn 1974a, b
	1974-76	80-100	109-136	Dekker 1986
	1983-89	50- 27	220-400	Dekker 1986,1989
AOSERP[a]	1976-77	166	151	Fuller and Keith 1980
Swan Hills	1976-77	24	83	Fuller and Keith 1980
Simonette R.	1975-76	15	92	Bjorge and Gunson 1983
	1979-80	40	42	Bjorge and Gunson 1983
Nordegg	1983-84	13	207	Clarkson et al. 1984
	1984-85	23	187	Schmidt and Gunson 1985
Wood Buffalo National Park (bison ranges)	1977-78	136	40-65	Oosenbrug and Carbyn 1985

[a]AOSERP = Alberta Oil Sands Environmental Research Program area.

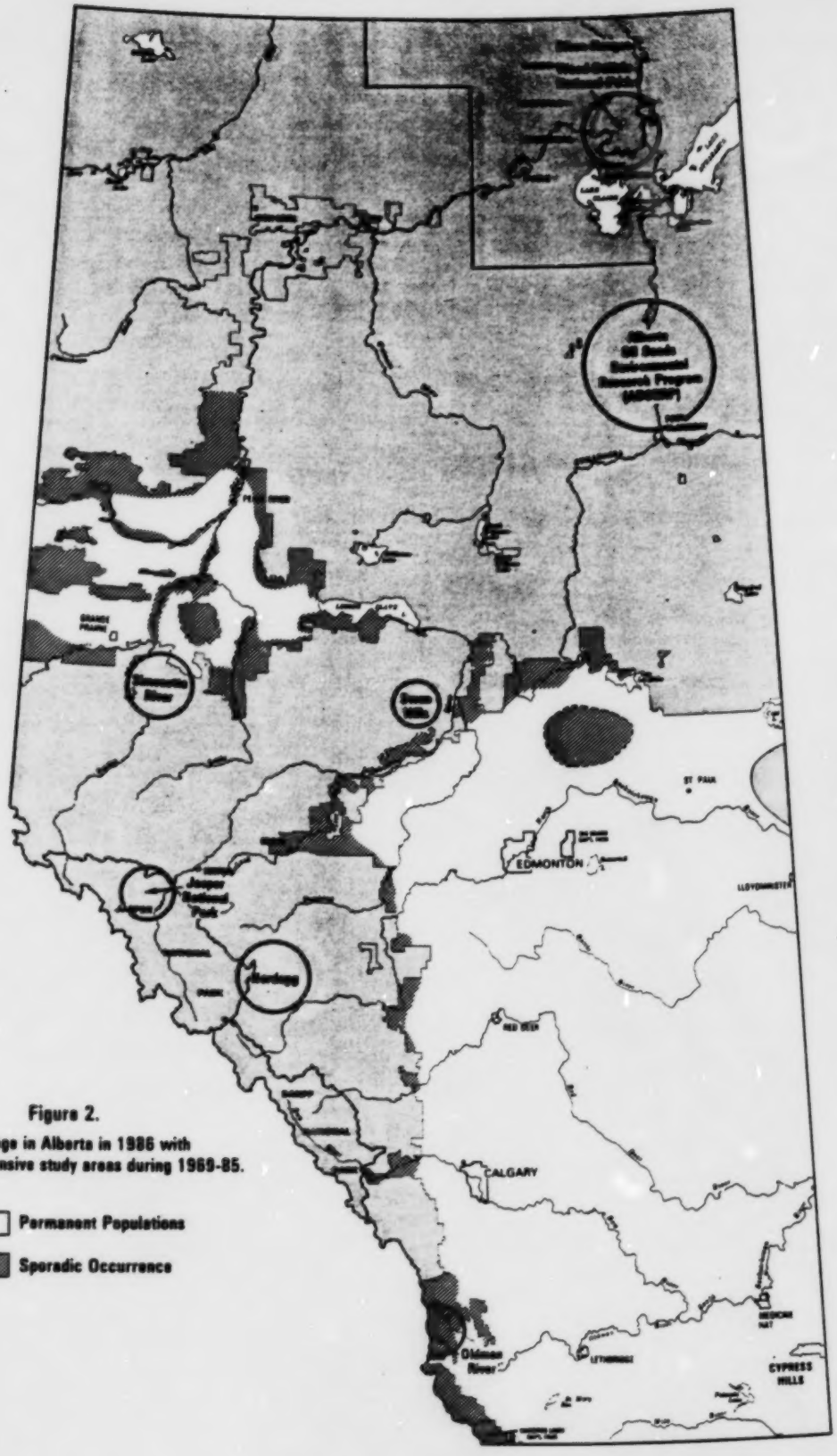

Figure 2.

Wolf range in Alberta in 1986 with locations of intensive study areas during 1969-85.

wolves, and the addition of 12 percent for lone wolves. The provincial estimate was 4200 wolves during winter; the population may decline to as low as 3500 by late winter. Numbers during summer would be 30 to 60 percent greater or as high as 5500 wolves.

2.3.1.2 Populations

2.3.1.2.1 Jasper National Park - From his own observations during 1965-89 and from park warden records, Dekker (1986, 1989) noted a decline in the number of wolves during the 1980s in JNP. This followed much higher estimated numbers in the mid-1970s, and the estimates of low densities during 1942-46 (225-286 km^2/wolf, Cowan 1947) and during 1969-73 (225 km^2/wolf, Carbyn 1974a, b).

2.3.1.2.2 AOSERP and Swan Hills (Fuller and Keith 1980)-

> "Population studies of wolves were carried out during October 1975 - June 1978 on 2 study areas in northern Alberta; 13 wolves in 6 packs and 2 lone wolves were captured, radio-collared and located 939 times. Telemetry data indicated a winter wolf density of 1/158 km^2 near Fort McMurray. Numbers increased from 1975 to 1977 at a rate of about 21% annually. The winter wolf density of 1/90 km^2 on a study area in the Swan Hills, 300 km southwest, appeared lower than in past years. The difference in wolf density between the 2 areas reflected available food resources. Trapping and early pup deaths were likely the major mortality factors. Wolf densities near disturbed sites were higher than in surrounding areas."

2.3.1.2.3 Simonette River (Bjorge and Gunson 1989)-

> "Wolf populations and prey relationships were studied during 1975-81 in northwestern Alberta as part of an evaluation of wolf predation of livestock. Density of wolves increased from one wolf/92 km^2 during the initial winter to one wolf/42 km^2 during the population high in 1979. Overall, 12% were lone wolves. Mean territory size of four packs over seven summers was 233 km^2 (100-276 km^2) compared to 424 km^2 (198-850 km^2) for four packs over nine winters. Average territory size of three packs over six years was 572 km^2 (296-878 km^2) compared to 2191 km^2 (607-4900 km^2) for lone wolves. Of 26 live-captured wolves, 54% were females and 23% were pups. Mean oversummer increase from late winter populations was 60% while overwinter loss averaged 30%. All packs produced pups each year."

2.3.1.2.4 Southwestern Alberta - As part of continuing investigations of wolves in northwestern Montana (Ream and Mattson 1982; Ream et al. 1987), where the wolf is rare and classified as endangered, occurrence of wolves in southwestern Alberta was determined by analysis of sightings (Harris 1981) and an intensive field study near the Oldman River in 1982 (Harris 1982; Ream and Harris 1986). Although no wolves were captured in 2171 trap-nights, a black adult wolf was twice observed by study personnel and seven other sightings including one of an adult and two pups were reported. Two wolves were shot in the area in the fall of 1982 and the study was terminated. The investigators concluded the liberal hunting and shooting regulations contributed significantly to the low population.

2.3.1.2.5 Nordegg (Clarkson et al. 1984; Schmidt and Gunson 1985) - Wolves were studied in the Nordegg area during 1983-85 in response to complaints by hunters of predation on big game. Six wolves in two packs were radiocollared. Densities during winter were 1 wolf/202 km^2 (1983-84) and 1 wolf/80 km^2 to 1 wolf/102 km^2 (1984-85) in the Baldy Pack near Nordegg and 1 wolf/209 km^2 (1983-84) and 1 wolf/175 km^2 to 1 wolf/246 km^2 (1984-85) in the Blackstone Pack in the high mountainous headwaters of the Brazeau, Blackstone and Bighorn rivers. Territory size of the two packs during two winters were 808 km^2 and 717 km^2 for the Baldy Pack and 1881 km^2 and 2455 km^2 for the Blackstone Pack.

2.3.1.2.6 Wood Buffalo National Park (Oosenbrug and Carbyn 1985)- Wolf population dynamics and wolf-bison relationships were investigated during 1978-81 when 43 wolves were radiocollared on the bison ranges in Wood Buffalo National Park. From surveys since 1971, mean pack size declined from 14.5 in 1973-74 to a low of 6.0 in 1975-76 and 1978-79. Percentage of lone wolves varied from 6 to 53 percent. The composite territory of one pack over three years was 3000 km^2. Temporary splitting and reforming of packs during winter was common.

2.3.2 Use

2.3.2.1 Fur Harvest

Licenced trappers capture wolves in steel leg-hold or foot traps and neck snares. Traps with toothed or studded jaws or with a jaw spread equal to or greater than 23 cm (9 in.) are illegal. Most wolves taken by professional trappers in Alberta are taken in neck snares of 3/32 or 1/8 in. diameter cable equipped with a locking device.

Before recent years, numbers of wolf pelts sold on the fur market have strongly reflected market demands and prices offered (Todd and Geisbrecht 1979). For example, during 1930-46 when prices averaged $12 a pelt, annual harvest averaged 360 pelts, whereas during 1947-58 average annual number of pelts marketed was 115 when prices averaged $5 (Figure 3).

During recent years, when average pelt value increased to the $70-$90 range and as high as $124 in 1978-79, harvest did not rise accordingly (Figure 3). During 1972-84, a period of high wolf numbers, the mean annual number of pelts on the fur market, including many wolves

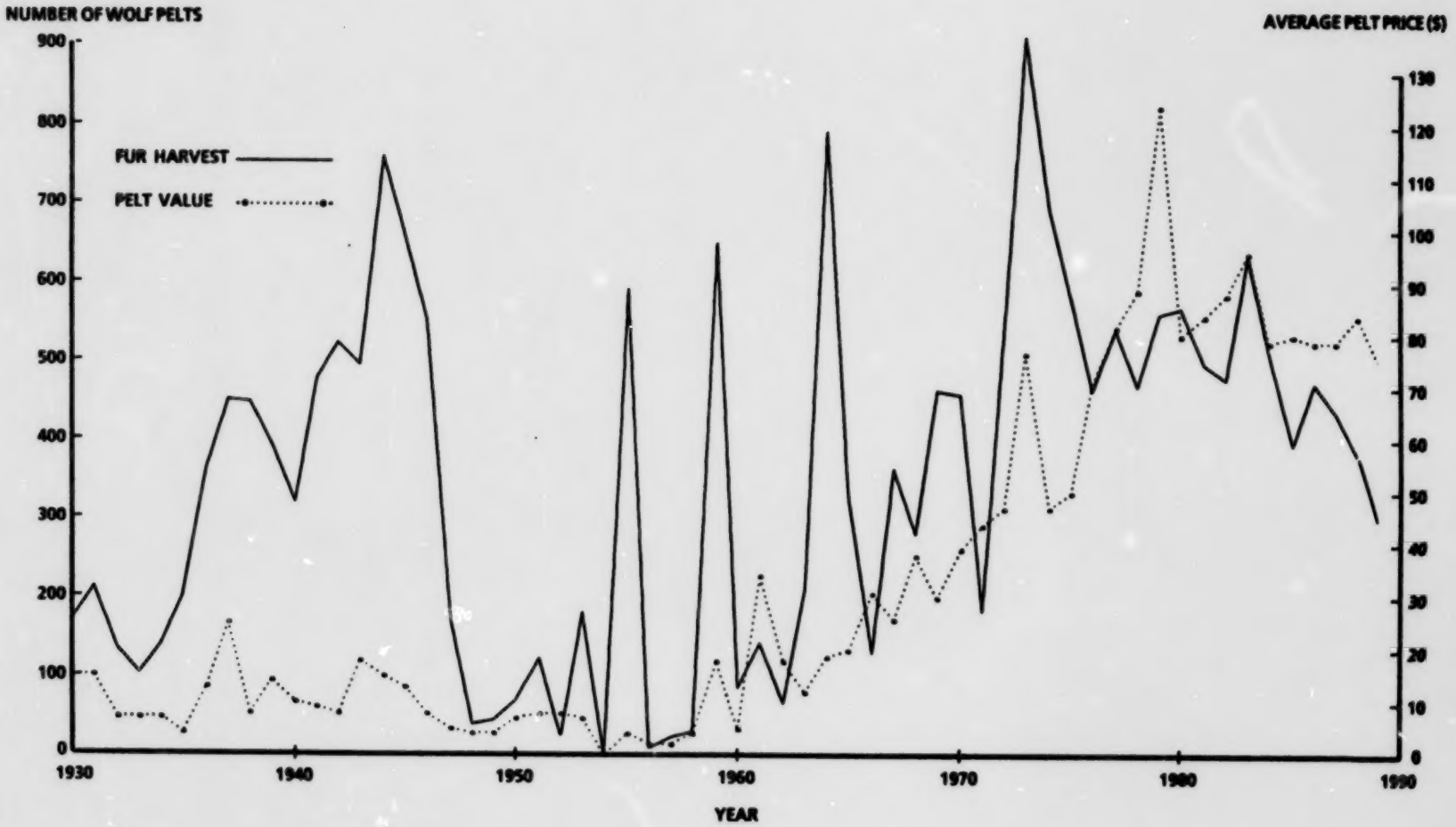

Figure 3. Number of wolf pelts sold annually and average pelt prices in Alberta from 1930 to 1989.

taken by landowners and hunters, was 556 pelts. Licenced trappers harvest a portion of these pelts. For example, average annual number of wolf pelts sold by registered trappers to fur dealers during 10 years, 1979-89, was 261. Actual wolf harvest by registered trappers is somewhat greater than indicated on fur dealer returns because some pelts are discarded (e.g., mange), sold elsewhere, or kept for own use. Actual harvest by registered trappers is recorded on fur affidavits (Report of Fur Animals Taken). These affidavits indicated an annual mean of 388 wolves captured over the 10 years. Trappers complain of difficulty of capture and that costs of capture, thawing, skinning and pelt preparation exceed market value.

2.3.2.2 Recreational Hunting

In the heavily forested areas north of the Bow River, the wary nature of wolves provides security from hunters. In the open foothills and mountain habitats south of the Bow River, wolves are more vulnerable to hunting. In this area, wolf distribution and density are limited by shooting from hunters, cattlemen and other landowners (Mattson and Ream 1980; Harris 1982; Ream and Harris 1986).

A search of one-half of the taxidermists' and tanners' records for four years provided numbers of wolf pelts of 65 (1986-87), 53 (1985-86), 62 (1984-85) and 61 (1983-84). Estimated annual average for wolf pelts handled by all taxidermists and tanners in Alberta during that period is 120. Because most, but not all, wolves were submitted by hunters, estimated annual provincial kill by hunters is about 100 wolves. Trappers and unlicenced sources (private landowners) also submit wolves to taxidermists.

2.3.3 Management

2.3.3.1 Bounty Management

Bounties were paid for wolves killed in the area south of the main line of the Canadian Pacific Railway that existed as a portion of the territory from 1899 to 1905, and the province from 1905 to 1907. Payments were administered by the Western Stock Growers' Association, which operated largely in that portion of the province (Dept. Agric., Ann. Reps., 1905, 1907). The following summary was taken from the 1907 annual report. The authorities of that time concluded the annual decline in wolves submitted for payment was evidence of gradual extermination of the wolf in southern Alberta.

Number of Timber Wolves Bountied

Year	Dogs	Bitches	Pups	Total
1899	75	43	336	454
1900	73	54	264	391
1901	68	68	238	374
1902	51	40	274	365
1903	19	22	289	330
1904	58	38	230	326
1905	33	21	170	224
1906	40	34	147	221
1907	24	18	122	164
1899-1907	441	338	2070	2849

The Legislature authorized the adoption by Order in Council in 1907 of regulations to extend the payment of bounty on wolves throughout the province. The 1907 report provided a report by the Chief Game Guardian, Mr. B. Lawton, summarizing the administration of wolf bounty

payments and advice on methods of taking wolves (Appendix I).

An "Act for the Payment of Wolf Bounty" was passed in February 1909 (Dept. Agric., Ann. Rep., 1909). By 1910, the bounty claimed was equally distributed between the north and the south of the province. Ten dollars was paid per adult timber wolf and $1 for a pup, the latter for prior to 1 August each year (Dept. Agric., Ann. Rep., 1910). In 1917, the payment for female wolves was increased to $20 (Dept Agric., Ann. Rep., 1917). Apparently the bounty was removed in 1920, reinstated shortly thereafter, removed again in 1931 (Clark 1933), reinstated in 1935 and finally terminated by agreement of wildlife administrators in western Canada in 1954-55 (Huestis 1954; Pimlott 1961).

The decline in numbers of timber wolves bountied during 1899-1907 in southern Alberta and the comments of S. Clark, Game Commissioner, in 1933, suggest the taking of wolves for bounty was effective in reducing wolf populations. In the 1933 annual report, Clark reported,

> "In addition to the depletion by humans, the timber wolves have greatly increased during the last few years. The bounty on these pests was removed in 1931, and as the wolves are difficult to trap, and as the fur is coarse and of little value, the trappers will not exert themselves to destroy them."

Many of the bountied wolves were taken by poison. As high as 1286 wolves were bountied during a single year, 1945-46. With a mean of 725 wolves bountied during the final 20 years of the program, it is noteworthy that fur harvests have never exceeded or equalled the bounty take even during recent years when pelt values have averaged $70-$90 (Figure 3).

The primary weakness of a bounty system to manage numbers of a species, is that it provides control "when and where wanted" rather than "when and where needed" (Pimlott 1961). Pimlott, Canada's leading wolf

authority in the 1960-70s, pointed out that the bounty system was "not necessarily the greatest evil"--other control programs could constitute a greater abuse. Although contemporary wildlife biologists have often considered bounty management to be an example of mismanagement (e.g., Theberge 1973; Carbyn 1983), the potential effectiveness of a regional subsidy incentive system in reducing wolf populations in critical areas should be determined. To be effective, the transport of wolves (or parts thereof) for payment, must be controlled.

2.3.3.2 Fur Management

Trapping of wild carnivore populations in unsettled areas may minimize dispersals into settled areas thereby reducing depredations and nuisances and the spread of diseases such as rabies (Todd 1981). Fur trapping of wolves is encouraged in Alberta in order to harvest a resource otherwise lost to natural mortality and to reduce effects of wolf predation on domestic and wild animals.

The first regulated trapping season for wolves was established in 1967--the season was 1 Sept.-30 Apr. In 1976, the wolf trapping season was lengthened to close the end of May. However, in 1980 the season was shortened to 1 Oct.-28 Feb. in order to promote better quality pelts - the earlier closure reduces the occurrence of "rubbed" pelts.

Trapping of wolves has been low as a result of:

i) their great mobility and infrequent occurrence in a specific area,

ii) wariness and difficulty of capture,

iii) occurrence of black colour phase (lower market value) in about 31 percent of the provincial population,

iv) occurrence of mange (Sarcoptes scabiei) in some wolves,

v) coarse hair of mediocre value, and

vi) variation in market demand and price.

Trappers may receive instruction in trapping techniques, fur handling, humane trapping, and fur management and regulations at trapper education courses held annually at various locations in the province. The courses, usually during evenings of one week, and reaching about 300 trappers annually, are jointly sponsored by the Alberta Vocational Centre, Lac La Biche and the Fish and Wildlife Division. Three-week advanced courses covering a broader range of subjects are also available to trappers.

In addition to the regular trapper education, 260 trappers were instructed in 11 special wolf trapping/snaring workshops in 1983. Participating trappers received 4780 complimentary snares. Three workshops were held in 1984. Although there was an initial first-year response in wolf harvest to 611 pelts in 1982-83, harvest declined again in 1983-84--494 pelts (Figure 3).

A government-trapper cooperative effort to increase trappers' harvests of wolves in an intensive wolf research area near Nordegg in 1985-86 failed. Despite the provision of baits and snares and snaring instruction, only 2 of 21 wolves in the former territory of the Blackstone Pack were trapped. Harvests of wolves by trappers did increase in the Rocky Mountain House area in 1986-87 following the provision of carcasses from roadkilled ungulates to trappers by government (Olsen and Epp 1987). In this program, 58 wolves were captured of which 25 escaped, accounting for a harvest of 33 wolves which was about three times the average harvest for the area.

2.3.3.3 Hunting Management

Between 1964 and 1984 wolves were classed as a "fur-bearing carnivore" which provided the authority for liberal shooting and hunting seasons in order to allow the protection of private property and to encourage harvest in remote areas. During that period, provincial residents could shoot a wolf on public lands in most Wildlife Management Units between the opening of the big game season in September and the end of April or May of the year following. Although wolves are no longer classified as in 1964-84, the long season continues. Resident wolf hunters required a wildlife certificate, the basic hunting licence to 1986, although prior to 1981, a valid big game licence was also required. In 1987, licence requirements for resident wolf hunting were dropped. There is no limit to the number of wolves taken by residents.

During 1975-83, nonresident hunters required a wolf licence (Canadian--$75, Alien--$150) and were limited to one wolf per season. To encourage harvest by nonresidents, the prices of the nonresident licences were reduced to $15 and $25 in 1983, followed by the elimination of the licence requirement in 1984. In 1989, the nonresident wolf licences were reinstated in order to provide additional wolf-hunting opportunities beyond the closure of the big game season.

On private lands, there are few restrictions to the shooting of wolves; residents that are landowners, have lawful possession of the land or permission of the landowner, may shoot wolves at any time of the year and without a licence. In 1984, the regulation providing authority to owners or occupants of private land or those authorized to maintain livestock on public lands to shoot wolves was amended to include grazing leases and areas within 8 km (5 mi.) of the private or grazing leased

lands. While baiting has been discouraged by policy, use of electronic calls has been prohibited by regulation.

2.3.3.4 Nuisance/Problem Management

2.3.3.4.1 Complaints - Complaints regarding nuisance or problem wolves are recorded by Fish and Wildlife officers on district occurrence reports. During 18 years, 1972-90, 2869 complaints were reported, an average of 159/yr. (range 74-231). (Table 2). Numbers of complaints peaked in the mid-1970s, in the early 1980s and in 1989-90 (Figure 4).

Since 1982, wolf complaints have been stored in the Division's computerized Animal Incident Reporting System (AIRS). Trends in complaints during 1982-83 to 1989-90 include an increase in Southern Region (1-29) a decline in Northeast Region (84-31), and a relatively stable regime in Eastern Slopes Region (Figure 5). Over eight years, 1982-90, Fish and Wildlife Districts with highest cumulative total of complaints were Valleyview (130), Peace River (119), Grande Prairie (113) and Athabasca (92).

Most complaints involve livestock; 985 or 69 percent of 1428 complaints during eight years, 1982-90 (Table 3). In addition, many of the complaints in the "sighting" class (23 percent of total) involve wolves sighted in livestock areas. Of the livestock complaints during 1982-90, cattle occurred most frequently - (73 percent), dog (7 percent), sheep (5 percent), horse (6 percent), poultry (2 percent), goat (1 percent) and others (4 percent).

Only occasional reports of wolf predation of livestock occurred during the 1960s (e.g., see Stelfox 1965a); however, complaints became more frequent in 1972 and have recurred annually. Depredations in the

Table 2. Summary of wolf complaints[a] and wolves killed by Alberta Fish and Wildlife during 1972-90.

Year	Complaints	Wolves Killed
1972-73	74	72
1973-74	114	88
1974-75	136	124
1975-76	178	144
1976-77	157	91
1977-78	164	71
1978-79	120	35
1979-80	156	78
1980-81	180	17
1981-82	162	22
1982-83	215	96
1983-84	231	109
1984-85	201	51
1985-86	148	23
1986-87	154	32
1987-88	145	14
1988-89	126	41
1989-90	208	92

[a]Data source for 1983-90 was the Animal Incident Reporting System (AIRS); data analysis by date of occurrence.

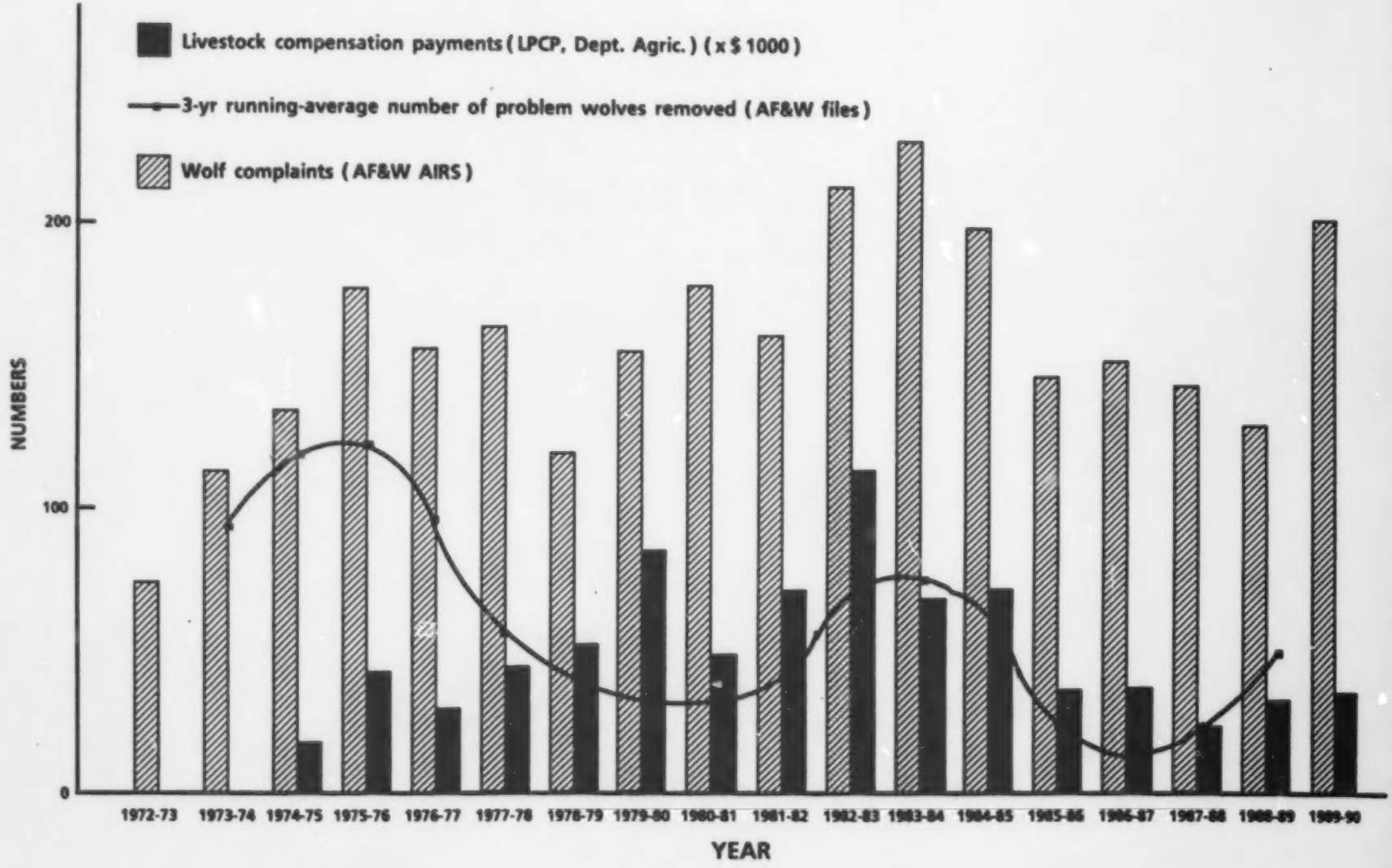

Figure 4. Trends in wolf complaints, livestock compensation payments and problem wolves removed in Alberta.

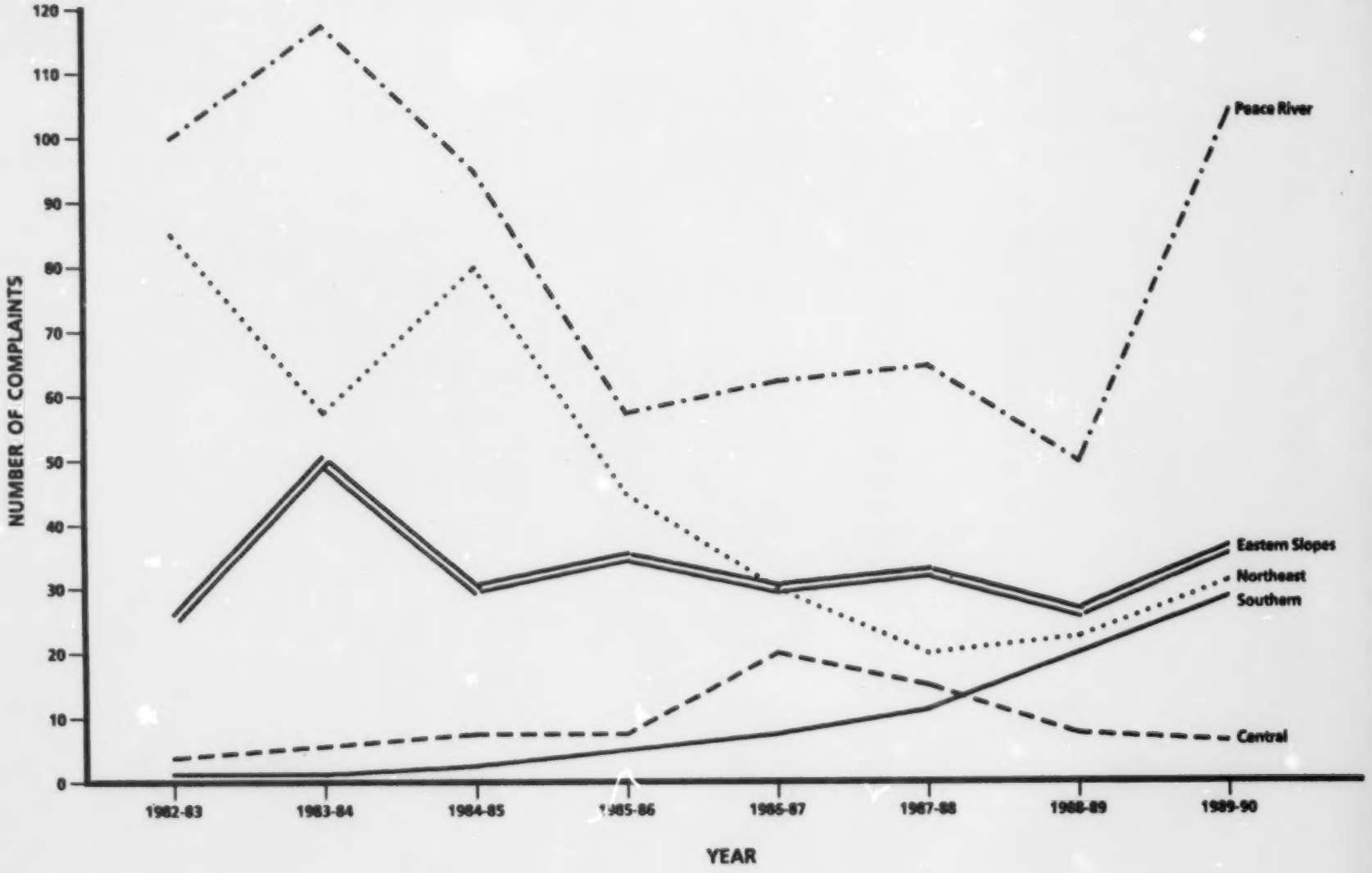

Figure 5. Trends in numbers of wolf complaints in five administrative regions in Alberta.

Table 3. Numbers of wolf property damage complaints in Alberta[a].

Type	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1982-90 Percent
Livestock[b]									
- Kill	93	119	114	78	60	62	41	77	45
- Mauling	17	18	8	9	12	7	14	12	7
- Harassment	35	38	35	22	38	26	24	26	17
Sighting[c]	65	50	40	29	33	40	41	81	27
Human[d]	1	2	2	5	3	4	2	6	2
Other	4	4	2	5	8	6	4	6	3
All types	215	231	201	148	154	145	126	208	101

[a]Data source = Animal Incident Reporting System (District Occurrence Reports).

[b]Includes dogs and horses.

[c]Sightings are entered as a property damage occurrence in those cases where there is concern, e.g., residential area, farms.

[d]These cases involve threats to humans.

forest-settlement fringe areas of the province are influenced by the numbers of wolves and wolf control, numbers of livestock, quality of animal husbandry, and potentially by the relative abundance of native prey. Because wolves often consume virtually all of each prey animal (Bjorge and Gunson 1983) and many kills occur on remote, forested grazing leases (e.g., Simonette River leases, 1976-81, 49 carcasses of 327 losses were found) complaints of missing animals occur.

2.3.3.4.2 Wolf Predation on the Simonette River Leases - To more fully understand wolf predation upon cattle, an intensive investigation of predation was carried out by the Division on remote leases near the Simonette River during 1975-81. In this project, cattle going in and out of leases were counted and classified by sex and age and as conditions permitted, monitored for location, behaviour and eventual losses. As well, wolves were captured, radiocollared and their numbers, movements and kills recorded (Bjorge and Gunson 1983, 1985, 1989).

Between 1975-79, when wolves were not controlled, wolves increased from about 15 to 40. Although wild ungulates, especially moose, constituted the bulk of the year-round diet of the wolves, cattle remains occurred in 20 percent of 245 summer scats. Wolves killed 17 (41 percent) of 41 cattle where the cause of death was known and mauled another 51 (Table 4). Cattle killed by wolves were primarily calves and yearlings. Because they were more completely consumed, carcasses from kills were more difficult to locate than cattle dying from other causes. Wolves were responsible for about 60 percent of the average annual cattle mortality (64) on the study area.

In a final phase of the project, wolves were controlled by

Table 4. Mortality of cattle and numbers of wolves on summer grazing leases in the vicinity of the Simonette River, northwestern Alberta (reprinted from Journal of Range Management 38:483-487, 1985).

Year	Cattle on Study Area	Cattle Mauled		Cattle Mortality					Loss		
		Predators[1]									
		Wolves	Bears	Wolves	Bears	Causes Other than predation	Unknown	Cattle Missing	Total	%	Wolves[2] Present
Before Wolf Control											
1976	2288	6	3	1	1	12[3]	1	50	65	2.9	23-25
1977	2023	5	3	1	0	1	3	65	70	3.5	29-33
1978	1784	13	2	3	1	1	1	58	64	3.6	28-31[4]
1979	1558	19	1	8	1	2	3	43	57	3.7	39-40
After Wolf Control											
1980	1772	8	1	3	1	2	0	38	44	2.5	16-17
1981	1804	0	1	1	0	2	0	24	27	1.6	3[4]

[1]These include only known predator kills. Other kills by wolves and bears occurred but were not detected due to remoteness, large pasture size, dense tree cover, and complete consumption.

[2]Wolves present during early winter.

[3]Seven cattle died from bloat following escape from a grazing lease.

[4]Six wolves were illegally removed during 1977-78 and 5 during 1980-81.

strychnine poisoning during two winters (Bjorge and Gunson 1985). Following control, there were about 13 wolves in 1980 and three wolves in early summer of 1981. Total losses of cattle in 1981 was 1.6 percent, down from 3.7 percent in 1979 when wolves were at peak numbers. Lone wolves and pairs were located on leases more often than packs and were less susceptible to winter wolf control because they often vacated lease areas during winter.

2.3.3.4.3 Management of Livestock Depredations -

Prevention - Although prevention of wolf predation of livestock, especially in remote areas is difficult, certain types of animal husbandry have been recommended by the Division (Gurba and Neave 1979; Bjorge 1980; Bjorge 1983; Bjorge and Gunson 1985). These recommendations may be summarized as follows: 1) cattlemen should check their herds regularly, send only healthy and non-pregnant cattle to pasture, and remove cattle from remote leases as early as possible in fall, 2) carrion should be buried or removed where possible, 3) grazing leases on public lands in the Green Area (Public Lands General Classification map, April 1986) should be kept within a few kilometres of the settlement boundary or phased out entirely, and 4) agriculturists who place cattle in remote areas should be advised that conflicts can be expected, losses to predation may occur, and governmental assistance will be minimal.

Compensation - The Alberta Livestock Predator Compensation Program (LPCP) (Hutchings 1986), initiated in 1974 but retroactive to 1972, compensates livestock owners for losses to predators. Administered by Alberta Agriculture, the program covers only food-producing stock and is the only

program of its kind in western Canada. Both Manitoba and Saskatchewan compensate for confirmed bear predation of livestock, but do not compensate for losses to wolves. Other wolf damage compensation programs are found in Italy (Zimen and Boitani 1979), Minnesota (S.H. Fritts unpubl.) and Ontario (Kolenosky 1983).

Standard livestock values, based on current markets, are re-established "from time to time" (e.g., "cow": 1974-$300, 1979-$700, 1990-$850). Market value of the loss must exceed $100 in a calendar year. Claims are reviewed by one of two regional committees composed of private producers and government representatives from the disciplines of animal health, animal production and wildlife management. To June 1990, losses were judged as "confirmed kill," "probable kill" or "missing animals" with corresponding levels of compensation - up to 80 percent of commercial value, 50 percent and 30 percent (50 percent in the case of missing animals where an official third party count of livestock was made prior to predation). Loss included fatality, injury from which recovery is deemed improbable, and disappearance of animals in conjunction with confirmed kills or injuries. Changes to the LPCP, effective June 1990, include the following: 1) 100% compensation on confirmed kills and 2) elimination of the "missing animals" categories. See Gunson (1983d) for a summary of wolf predation compensation to 1980.

Numbers of approved claims and dollars paid are provided in Table 5.

Control - Year-round, unlicenced and unrestricted shooting of wolves on private lands in Alberta is allowed for protection of livestock, pets and humans as indicated in Section 2.3.3.3.

Table 5. Numbers of claims approved for payment and dollars paid for wolf predation of livestock in Alberta[a].

Year	Approved Claims	Dollars Paid
1972	22	14 993
1973	38	17 305
1974	39	17 587
1975	79	43 367
1976	42	29 828
1977	71	45 217
1978	56	52 395
1979	59	85 122
1980	40	49 064
1981	64	70 547
1982	65	115 296
1983	77	68 019
1984	68	71 466
1985	46	36 834
1986	58	37 830
1987	37	24 334
1988	47	25 063
1989	42	27 810

[a]Source: Chairman, Livestock Predator Compensation Program, Animal Nutrition, Alberta Agriculture, O.S. Longman Building, P.O. Box 8070, Postal Station F, Edmonton, Alberta, T6H 4P2.

Governmental control usually involves the placement of strychnine baits in areas of depredations during the winter following confirmed or highly probable predation (Gurba and Neave 1979; Bjorge and Gunson 1985). Such control is partly reactive and partly preventive. Control is coordinated by Regional/Enforcement Field Services and Wildlife personnel and is not to be conducted more than 19 km (12 mi.) into the Green Area. Wolf control can be effective in reducing losses generally for about one year; depredations often recur during the second year following control.

Strychnine has high toxicity and can be effective in taking wolves. Most wolves taken with strychnine die near bait stations and thus may be counted and, if desired, retrieved. Buried drop baits, each with two cubes or a total of 200 mg-280 mg of strychnine per bait, are placed around an unpoisoned draw bait (Horstman and Gunson 1983; R. Flath pers. comm.). At an approximate LD50 of 0.70 mg/kg (coyote) to 1.0 mg/kg-1.2 mg/kg (dog) (Timm 1983), 40 mg-70 mg of strychnine are required per wolf.

Numbers of wolves killed during 18 years, 1972-90, was 1200 - a mean of 67 wolves per year (Table 2). A few nontarget mammals and birds were taken, commonly coyotes, ravens and magpies (Bjorge and Gunson 1985). The use of strychnine, to remove wolves depredating on domestic animals or constituting a threat to human safety, is regulated by the federal Pest Control Products Act. Registration 20410 allows this use in Alberta.

2.3.3.5 Predation of Ungulates

2.3.3.5.1 Historical Review in Alberta - Governmental programs to manage wolves for ungulate management reasons date back to the late 1940s. Following a build-up of wolf populations during the 1930s and

1940s, residents and big game guides and outfitters complained of few moose calves (Huestis 1945; Soper 1948; Stelfox 1969). This prompted the legislation of snares on registered traplines and the distribution of cyanide guns to field staff to control wolves and coyotes in forested areas, although these measures were generally ineffective (Huestis 1951).

Hoofed mammals increased dramatically in the province during 1953-64 because of mild winters, beneficial changes to their habitat by logging and fires, and few wolves (Stelfox 1955, 1964, 1966). The low wolf population was a result of wolf removal during the anti-rabies program of the 1950s (Ballantyne 1958). During the late 1950s and early 1960s attempts were made to integrate wolf control with big game numbers, range conditions, wolf populations and hunter harvests (Stelfox 1958). However, numbers of wolves removed were low, in part because wolves were still uncommon in most areas. The final year of wolf control for wildlife management purposes was 1965-66, when 73 wolves were removed.

Wolves increased in range and numbers once again, reaching peak numbers during 1972-76 (Gunson 1983a). Despite organized complaints of hunters concerning the effects of wolves on big game [see Gunson (1984) for examples], control has not been reinstated. During the 1970s, this was related to a growing appreciation of wolves and other predators and a reluctance by wildlife managers and government to interfere with natural wolf-prey relationships. More recently, wildlife managers have recommended wolf control in cases where wolf predation was the major limitation to declining or low density ungulate populations (Edmonds 1986), but the lack of socially acceptable means of wolf control and apprehension of ensuing public controversy delayed implementation. A more detailed historical review of wolf management to enhance big game

populations is provided in Gunson (1984) and a summary is provided in Table 6.

2.3.3.5.2 Research in Alberta - Effect of wolf predation on ungulates on provincial lands in Alberta has been investigated in five locations since 1969. Results are described below and in Table 7.

Willmore Wilderness Park and adjacent foothills

Twelve of 22 radiocollared woodland caribou died during 1981-85. Of these 12, 10 were believed to be killed by predators, at least 6 by wolves (Edmonds pers. comm.). In an earlier survey during 1969-70, 41 of 133 (31 percent) wolf scats contained caribou hair (Edmonds and Bloomfield 1984). Edmonds believes wolf and bear predation is a major source of mortality of adult caribou in this area. Effect of wolf predation on caribou calves needs investigation.

AOSERP (Alberta Oil Sands Environmental Research Program) in northeastern Alberta

Fuller and Keith (1980) observed wolf predation of moose during 1975-78. They summarized their observations as follows:

> "Wolves killed disproportionately more young, old, and probably debilitated moose (Alces alces), as well as more female calves and adult bulls. Most wolf kills in winter (88%) were made in lowland habitats despite an even distribution of moose in uplands and lowlands. Deeper snow and colder temperatures in 1978 resulted in decreased travel by 1 pack (straight-line distances between daily locations of 5.7 vs. 9.0 km/day). The mean kill rate of this pack was similar in both years (1 moose/4.7 days); per capita consumption decreased slightly in 1978 (0.12 vs. 0.15 kg prey/kg wolf/day) because of larger mean pack size (9.8 vs. 9.2). An equation was derived for calculating true kill rates when relocation flights were spaced more than 1 day apart. Summer food habits of wolves (1,723 scats

Table 6. Summary of changes in wolf and big game populations and wolf control in Alberta (excluding national parks) during 1943-88 (modified from Gunson 1984).

Years	Wolf Numbers	Wolf Control	Livestock Predation	Big Game Numbers	Factors Contributing to Big Game Numbers
1943-47	Increasing[1]	Bounty Snares on trap-lines[2]	Severe in PR Region[3]	Plentiful in 1943. Moose low in north in 1946[4]	Native hunting, wolves, ticks[2,3,4]
1948-51	High[4]	Initiated in Green Area for big game[5]	Common, poisoning by landowners	Moose stable or declining in west[4]	Wolves[4,5,6]
1952-56	Drastically reduced[7,8]	Estimated kill - 5461 for rabies control Bounty eliminated in 1954/55		Moose and deer increasing. Moose twins common[8,9]	Forest fires, logging beneficial[10]. Lack of wolves[8]
1957-66	Slowly increasing[11]	Rare localized for big game[12,13,14]	Rare	Expanding populations[10] Densities of 2.5 moose/mi^2 in west	Habitat changes beneficial Few wolves initially. One very severe winter, 1964-65[15]
1967-71	Increasing throughout Green Area[1]	Occasional/ livestock[16]. No control for big game.	Occasional complaints[16]	Moose populations high[17]	Hunter harvests increasing dramatically[18] Use of ATVs by hunters
1972-83	Stabilized and high[19] Increase only in southwest	Annual removal/ livestock[20] (835 wolves/11 yrs, mean = 76 wolves/yr) No control for big game	Complaints common (1077/8 yrs, mean = 135)[20]	Moose slowly declining in Ft. McMurray area[21,22] Complaints of big game decreases in Nordegg, Cadomin, Big Smoky R, others[23]	Mild winters except 73-74 and 81-82. Moose die-off - ticks[22] Wolves, other predators?
1984-88	Decline (Figure 1)	As in 1972-83	Mean of 176 complaints per year[23]	Caribou threatened[24] Elk in northern habitats much reduced[25] Moose declining[26]	Wolf[24,27], bear predation[28] Mild winters Moose harvests high

[1]Stelfox 1969
[2]Huestis 1945
[3]Soper 1948
[4]Forsland 1949
[5]Huestis 1951
[6]Huestis 1953
[7]Ballantyne 1958
[8]Ballantyne & O'Donaghue 1954
[9]Huestis 1957
[10]Stelfox 1966
[11]Cahalane 1963
[12]Stelfox 1964
[13]Stelfox 1965a
[14]Kemp 1966
[15]AF&W Ann. Rep. 1966
[16]AF&W Ann. Rep. 1968
[17]G. Lynch pers. comm.
[18]Smith 1968
[19]Gunson 1983a
[20]Gunson 1983d
[21]Fuller & Keith 1980
[22]B. Rippin pers. comm.
[23]AF&W files
[24]Edmonds 1986
[25]AF&W 1990
[26]G. Lynch, unpubl.
[27]Gunson et al. in prep.
[28]Nolan and Barrett 1985

Table 7. Summary of wolf/big game research in Alberta (excluding national parks).

Area	Year	Major Prey	Prey Populations	Winter Wolf Density	Effect of Wolf Predation	Source
Willmore Wild. Park and adjacent foothills	1969-70	Caribou	Declining	Unknown		Stelfox 1966
	1979-83	Caribou	Low (declining) (1/48 km^2)	Unknown	Wolf and bear predation suspected to be major source of mortality on severely reduced population.	Edmonds and Bloomfield 1984 Edmonds 1986
AOSERP, NE Alta. Muskeg River Pack	1975-78	Moose	Low (stable or declining) (1/4 km^2 to 1/33 km^2)	1/151 km^2	The major source of mortality to a declining population (28 moose/wolf).	Fuller and Keith 1980 Hauge and Keith 1981
Swan Hills Foley pack	1976-77	Moose	High (slightly increasing) (1/0.5 km^2 to 1/1.0 km^2)	1/83 km^2	Not limiting (99 moose/wolf).	Lynch, pers. comm. Fuller and Keith 1980
Simonette River Muskeg Lake Pack	1975-81	Moose	High (stable) (1/0.6 km^2 to 1/1.4 km^2)	1/42 km^2 to 1/90 km^2	Not limiting (56-71 moose/wolf). 0.020/w/day	Bjorge and Gunson 1989
		Elk	Stable (7% of total ungulates)		Killed at three times rate of moose per availability-major mortality.	
Nordegg Blackstone Pack	1983-85	Elk	Declining	1/202 km^2 to 1/175 km^2	Predation by one pack was major mortality to declining, unproductive elk population.	Clarkson et al. 1984 Schmidt and Gunson 1985
Baldy Pack		Moose	Declining	1/209 km^2 to 1/80 km^2		

analyzed) indicated that adult moose remained the staple food in all areas. Use of beaver (Castor canadensis) was related to availability. One wolf pack annually consumed about 15% of the yearling and older moose in their territory, close to the estimated 19% annual recruitment of new yearlings. Two lone wolves and 2 packs were partially dependent on dumps for food during winter; predation rates by these packs were much lower."

Swan Hills in central Alberta

The Foley Lake Pack of seven wolves in the Swan Hills consumed moose at a slightly higher rate than the Muskeg River Pack in the AOSERP area (Fuller and Keith 1980). For the Foley Lake Pack, the calculated number of moose kills per wolf per day was 0.027. Moose densities were up to nine times higher in the Swan Hills area (1-2/km^2, G.Lynch unpubl.) than in AOSERP. Moose remains occurred in 75 percent of 77 wolf scats collected in this area.

Simonette River in northwestern Alberta

Predation by four packs of wolves was observed in the Simonette River area during 1975-81 (Bjorge and Gunson 1989).

> "Minimum consumption rate for one pack during 51 days in winter was 0.12 kg/kg wolf/day. Of 61 kills examined, 39 were moose, 17 elk and five deer. Old moose (9.5 yrs.) were represented in wolf kills more often than in hunter kills while the opposite was true for moose 1.5 - 8.5 years. Among elk, wolves killed primarily calves and young cows. Wolves selected elk over moose."

The investigators related the lack of regulatory predation in this instance to the diversity of prey, the abundance of moose in habitat of high productivity, to the mild winters and to a wolf population that had not reached greatest possible density.

Nordegg in mountainous, western Alberta

Elk were the most important prey of the Blackstone Pack and represented 72 percent of 25 kills in 1983-84 and 38 percent of 34 kills

in 1984-85. Kill rates during two winters, 1983-84 and 1984-85 were 1 kill/2.5-2.6 days. Beaver, livestock and hunting-related carcasses were not common in this remote mountainous area, and year-round consumption of ungulates (elk, moose, mule deer, bighorn sheep and feral horse) was estimated at 112 to 126 animals (Gunson et al. in prep.). The pack preyed on elk nursery herds along the First Range during July. Production indices were 6 calves/100 cows by late July, 1985 and 4 calves/100 cows in 1986. Wolf predation was the major source of mortality of this declining, unproductive elk herd.

Moose and mule deer were the most important summer and winter foods of the Baldy Pack. This pack made a kill every 6.5 days in 1983-84 (4 wolves) and every 4.8 days in 1984-85 (7 wolves).

National Parks

In WBNP up to 50 percent of wolf activity during winter was in close association with bison (Oosenbrug and Carbyn 1985). A total of 143 wolf/bison interactions were documented. Of 65 wolf/bison encounters observed from aircraft, 17 included attacks of which 3 resulted in kills. Packs remained with herds up to six days. One pack made a kill every 6.8 days; 40 of 42 kills were bison, 2 were moose. Calves and old bison were most vulnerable to predation. In all cases, bison carcasses were completely consumed in one month. One pack spent a mean of 2.4 days at bison kills. Consumption averaged 4.3 kg/wolf/day (range 2.5-6.4). A combination of low production and wolf predation was considered to be important in bison declines.

In JNP, predation by wolves was studied during 1969-72 in portions of the Athabasca and Snake Indian rivers as well as Willow Creek (Carbyn 1974b). Scat analyses indicated mule deer were the most important prey occuring in 43 percent of scats. Elk contributed about 30 percent of the annual diet of the pack.

2.4 Summary and Management Issues

2.4.1 Summary

During the twentieth century, wolf populations in Alberta have experienced two major cycles of scarcity and abundance related to prey populations and human control. These demographic changes may be summarized as follows:

1900-1920s	low populations resulted from scarcity of ungulate prey and bounty-supported poisonings, trapping and shooting.
1930-1951	southerly expansion in distribution and numbers with peak populations in the late 1940s and early 1950s.
1952-1966	severe decline resulting from rabies control and big game enhancement.
1966-present	increase to the mid-1970s; stabilization during the late 1970s followed by a decline during the 1980s.

Wolf populations have remained relatively abundant during recent years, with province-wide estimates ranging from a late-winter low of 3500-4000 to early summer highs of 5000-5500 following the birth of pups. Estimated densities on six intensive study areas (five with radio-collared wolves) ranged from 1 wolf/40km^2 to 1 wolf/225 km^2.

Natural wariness, great mobility, and poor economics resulting

from a coarse fur, black colour phases and mange have provided little incentive for fur harvest by trappers. The average sale of wolf pelts on the fur market of 507/yr [range 296 (1988/89) - 880 (1972-73)] during 1972-89, is well below the estimated sustainable harvest.

Although predation by wolves on livestock occurs annually, the severity of the problem is reduced by 1) liberal regulations allowing the year-round shooting of wolves on private lands and on or near grazing leases, 2) government control in damage areas, and 3) compensation payments. Preventive husbandry, including regular checks and early removal of stock, is recommended on remote grazing leases, where losses to predators can be high.

Research in Alberta during the 1970-80s identified wolf predation as an important limiting factor to woodland caribou in the Willmore-Grande Cache area, elk in the Brazeau-Blackstone rivers area of the Eastern Slopes and moose near Fort McMurray. Despite requests by hunters and wildlife managers for reduction of wolves to enhance certain big game populations--especially in mountain habitats of western Alberta-- control has not been implemented. This has resulted from a growing appreciation of wolves and other predators and a reluctance of wildlife managers and government to interfere with natural wolf-prey relationships. Apprehension of ensuing public controversy has delayed use of controversial methods of wolf control such as toxicants or aerial shooting. Use of more socially acceptable methods, including incentives to registered trappers, or government trappers, might provide the reduced levels of wolf populations demanded by consumptive users. Plans in 1986-87 to reduce wolf populations to restore threatened populations of woodland caribou were postponed because of public controversy.

2.4.2 Management Issues

There is general agreement that wolves and natural wolf-prey relationships should be maintained in Alberta. As well, Albertans would probably support some encouragement of wolves in southern Alberta to assist wolf recovery south of the international boundary. But, what is a reasonable population goal for wolves in Alberta? Should the province maintain the current winter population of 4000 wolves?

A wolf management issue requiring resolution is the question of wolf management on public lands leased for grazing of livestock. Should government continue to allow the liberal shooting regulations in these areas? Should the present system of wolf removal and compensation be maintained on public lands?

Other than the long-term maintenance of viable wolf populations, no issue involving wolves in Alberta is more important than manipulation of wolves for population enhancement of other wildlife species. Certain caribou, elk and moose populations will probably continue at very low levels effectively regulated by natural predation. In the absence of large-scale ungulate habitat enhancement programs, should wolves be reduced to meet ungulate population objectives?

One of the most controversial aspects of wolf management is the method of wolf population reduction. If wolf control is to be conducted, should government utilize an effective and inexpensive method such as toxicants, or should aerial shooting be used, a technique that is highly selective and effective in certain habitats? Should government encourage trapping and recreational hunting which have been ineffective in the past?

- - - - -

These issues and others are addressed in the following Management Plan. Goals, objectives, strategies and actions are detailed.

3.0 MANAGEMENT PLAN

3.1 Policy Framework

The Fish and Wildlife Policy for Alberta (Alberta Fish and Wildlife 1982) establishes policy goals for the administration of wildlife resources in Alberta. These policy goals, set out under five general categories, provide a framework for the formation of specific wolf management goals.

3.1.1 Resource Protection

"1) ... The primary consideration of the Government is to ensure that wildlife populations are protected from severe decline and that viable populations are maintained...."

3.1.2 Resource Allocation

"[2)](a) The wildlife resource, as a Crown resource, will be utilized in a manner which contributes the most benefit to the citizens of Alberta.

"[2)](e) Wildlife will be allocated through a defined process whereby specific resources are deployed to specified uses in order to achieve stated public benefits.

"11) The Division may allocate live wildlife for various uses ...in conformity with other aspects of the Wildlife Policy.

"17) Wildlife must be allocated among different primary users in response to government policy. Until such time as supply and demand can be better rationalized, the following interim allocation guidelines will prevail in order of priority:

(a) Commercial harvest of fur bearers will have precedence over recreational harvest of fur bearers.

(b) Resident recreational use of game will have precedence over non-resident use. Wildlife stocks not fully allocated or utilized to higher priority uses may be allocated commercially to non-residents.

"18) The allocation of wildlife stocks to the different

primary uses does not imply that other uses cannot occur within areas where such uses are entitled.

"[22)(b)(ii)] (a) Formally allocating wildlife to tourist lodge and/or outfitter use."

3.1.3 Recreational Use

"8) A variety of wildlife recreational opportunities, in addition to hunting, will be available for the benefit and enjoyment of Albertans.

"21) A variety of hunting opportunities will be available for the recreational benefit and enjoyment of Albertans...."

3.1.4 Commercial Use

"22) The Division will encourage an environment that promotes the growth of the tourist industry...."

3.1.5 Protection of Private Property

"4) The Government, through the Division, will assist in preventing or controlling wildlife from damaging property and endangering human life.

"5) Responsibility for damage in any form caused by wildlife will be shared in relationship to what people can reasonably do for themselves and to the amount of any additional damage beyond that which would normally be expected to occur in an area."

3.2 Management Goals and Objectives

3.2.1 Resource Protection and Population Management

Goal: To ensure the provincial wolf resource is protected from irreversible decline and that current populations are maintained at viable levels and managed to meet the following goals and objectives.

Objective:

a) Over the long term, maintain a winter population of 4000 wolves in Alberta, distributed as follows:

Region	Winter Wolf Population Goal
Southern	50
Central	50
Eastern Slopes	750
Peace River	1950
Northeast	1200
All Regions	4000

3.2.2 Resource Allocation

Goal: To maximize benefits to Albertans through the optimum allocation of the wolf resource amongst recreational, commercial and other users.

Objectives:

a) Provide Albertans and visitors to Alberta the opportunity to view, listen to, photograph and otherwise enjoy the wolf resource.

b) Provide the opportunity for zoos and other licenced premises to possess and propagate wolves for public display and education.

c) Provide the opportunity for fur trappers to annually harvest 20 to 25 percent of the provincial wolf population.

d) Provide the opportunity for recreational hunters to annually harvest 5 to 10 percent of the provincial wolf population.

3.2.3 Commercial Use

Goal: To provide commercial benefits to Albertans from the wolf resource.

Objectives:

a) Promote trapping of wolves for fur and provide for an annual potential harvest of approximately 900 wolves to commercial/recreational trappers.

b) Maximize the opportunity for Albertans to outfit and guide non-resident wolf hunters.

3.2.4 Recreational Use

Goal: To maximize the recreational benefits to and enjoyment of Albertans from the wolf resource through the provision of a variety of recreational opportunities.

Objectives:

a) Promote hunting of wolves and provide for an annual harvest of approximately 300 wolves to recreational hunters.

b) Promote other recreational uses such as observation and photography.

3.2.5 Protection of Life and Property

Goal: To minimize property damage and other hazards to humans caused by wolves.

Objectives:

a) Ensure that wolf population objectives are sensitive to local public concerns.

b) Ensure wolf predation of livestock and pets is reduced as much as possible by planned land management and agricultural development and by preventive livestock management.

c) Reduce economic loss attributable to wolf predation by continuing the Livestock Predator Compensation Program.

d) Reduce the occurrence of chronic wolf problems on private lands by wolf removal.

e) In unusual or serious situations, control wolf populations to manage distribution and prevalence of diseases communicable to other wildlife and to humans.

3.2.6 Science and Education

Goal: To promote and encourage scientific and educational activity to enhance knowledge of wolves.

Objectives:

a) Continue scientific research of wolf populations, wolf characteristics and effects of wolf predation in Alberta.

b) Educate Albertans about wolves and wolf management.

3.3 Management Strategies

3.3.1 Resource Protection

Because wolves depend primarily on ungulates for food (see Section 2.2.7), long-term survival of wolves in Alberta requires successful management of moose, caribou, elk, deer, bighorn sheep, and bison populations. To accomplish this, appropriate strategies are detailed in the respective species management plans. Fundamental to ungulate management are habitat protection measures, of which inventory, retention and enhancement are important components. As with ungulates, control of human access can be critical to wolves [e.g., northwestern

Montana (USFWS 1987) and southwestern Alberta]. Although specific road densities and other access-related strategies for wolves are not recommended at this time, these may become considerations for the future management of wolves in Alberta.

3.3.2 Resource Allocation

The following allocation of annual wolf harvest will be implemented for Alberta:

a. commercial benefits (fur trapping, outfitting) 75%

b. recreational hunting benefits 24%

c. other benefits (zoos, etc.) 1%

This is based on an average annual harvest of approximately 1200 wolves.

3.3.3 Fur Management

Fur harvest of wolves should be encouraged to utilize a resource otherwise lost to natural mortality as well as to meet the goal and objectives in Section 3.2.5. Because trapping of wolves in Alberta is not currently profitable as a result, in part, of low fur quality, government will continue trapper education and incentive programs. Special courses on wolf capture techniques should continue and rewards for wolves trapped will be considered in identified areas.

As much as possible, open seasons for trapping wolves on public lands should be restricted to the period of pelt primeness, that is, October-February, inclusive. However, seasons may be longer where greater harvests are required as identified under other goals and objectives.

3.3.4 Hunting Management

Hunting of wolves should be promoted north of the Bow River to enhance recreational and commercial benefits. This can be accomplished by the following:

a. maintenance of the long, open season (e.g., early Sept.-end May),
b. promotion of the wolf as a "trophy" carnivore similar to cougar or grizzly bear,
c. education of hunters (e.g., Alta. Fish and Game Assoc. clubs) regarding the values of harvesting wolves,
d. research and development of methods of hunting wolves, and,
e. allowing the use of baits and electronic calls in wolf hunting.

South of the Bow River, where wolf populations are few or sporadic and problems are rare, the recreational hunting season will be shorter (e.g., early Oct.-end Feb.).

3.3.5 Population Inventory

Numbers of wolves will be inventoried to determine:

i) trends in regional or provincial populations,
ii) wolf abundance where ungulate populations are depressed, and
iii) results of wolf control.

Greater effort will be made by the Division to inventory regional wolf populations. Wolf surveys are routine in some jurisdictions where

open or semi-treed habitats are common (Stephenson 1978; Hayes et al. 1985), and are a fraction of the cost of ungulate surveys (R. Hayes pers. comm.). Aircraft are used to search for fresh wolf tracks after recent snowfall. Aerial tracking can result in wolf sightings and counts. Where conifer tree cover is not excessive, fixed-wing aircraft [e.g., Maule LR7, PA18 Supercub (R. Hayes, Yukon Wildl. unpubl.)] may be used, although rotary-wing aircraft may be necessary in parts of heavily treed Alberta.

Initial priorities for wolf inventory are those populations associated with the Willmore-Grande Cache caribou population, the northern mountain elk herds and certain northern moose populations. Observations of wolves by registered trappers, recorded through the registered trapper questionnaire, will be the major tool used to monitor regional and provincial wolf population trends.

Recovery of wolf populations in northern Montana may depend, in part, on survival and migration of wolves in southern Alberta (USFWS 1987). A registry of wolf observations should be initiated in Southern Region to assist authorities involved in wolf recovery south of the border.

3.3.6 Management of Wolf/Prey Relationships

3.3.6.1 Wolf/Prey Dynamics

A midwinter population of 4000 wolves is a reasonable, long-term population objective for Alberta, including the national parks. To support this objective, about 40 000 ungulate prey are required annually. This, in turn, requires healthy diverse ungulate populations and from 200 000 km^2 (at 50 km^2/wolf) to 400 000 km^2 (at 100 km^2/wolf) of forested

habitat. Moose, elk, deer, bighorn sheep and caribou populations require intensive management to support this level of predation in addition to the mortality associated with subsistence, recreational and commercial harvests by humans.

The recognition that prey populations at low densities can be held there by predation alone has resulted in the implementation of government wolf reduction programs in several Canadian provinces, territories and in Alaska. The objective of wolf reduction has not been to eliminate wolves, but to temporarily reduce their numbers and thus allow prey populations to increase. Significant improvement in ungulate populations can be quickly realized. In virtually all cases where wolves have been removed and wolves were the primary source of predation, calf recruitment and ungulate populations eventually increased (Gasaway et al. 1983; Elliott 1985a, 1985b; Hayes and Farnell 1985; Atkinson and Janz 1986).

Gasaway (1989), working in Alaska, warned that delayed predator control results in slower recovery. He also pointed out that predator control and resulting recovered prey populations can lead to wilderness preservation through increase of human use and enjoyment of enhanced wildlife populations.

3.3.6.2 Wolf Population Reduction For Ungulate Restoration

Wolf population reductions for ungulate restoration and enhancement will be considered in two situations in Alberta:

a) where endangered, threatened or rare populations of ungulates (e.g., woodland caribou) require restoration and wolf predation has been identified as an important limitation, and

b) where other ungulate populations with high consumptive or nonconsumptive demands are at low density or are declining, and where wolf predation has been identified as the proximate limitation.

Wolf population reductions in specific areas will be proposed only upon completion of regional operational plans which provide up-to-date wolf and ungulate population data, sound scientific evidence that wolf predation is a primary limiting factor, cost-benefit analyses, and specific budgetary details including sources of funding. In addition to wolf reduction, these plans will identify habitat protection and enhancement measures, restrictions on recreational, subsistence and commercial ungulate harvests, and other strategies required to restore ungulate populations. Operational plans that include wolf reductions will be submitted to a full public review process.

When a decision is made to reduce wolf poulations in specific areas, assistance will be provided to wolf trappers. Assistance may include the following:

i) complimentary wolf snares or traps,

ii) provision of baits (beaver carcasses, road-killed ungulates) where possible, and

iii) reimbursement over and above the market value of the pelt in identified areas.

In those situations where trapper incentives fail to reduce wolf populations, and other methods of ungulate restoration such as habitat enhancement are relatively ineffective, impractical or undesired, wolf populations will be reduced using contract trappers. Wolf control will be temporary, up to about five years in duration. Once prey

population objectives are met, wolf populations will be allowed to return to natural densities. Wolf reduction will not exceed 70 percent (Gasaway et al. 1983) of the pre-control population.

Methods of wolf control will be as effective, selective and humane as possible. Wolves will not be controlled in provincial parks or wilderness areas.

3.3.7 Protection of Private Property

The Division will provide advice on damage prevention, an annual control program where required, and investigational and review expertise of compensation claims to reduce the effect of wolf predation on livestock and pets.

3.3.7.1 Prevention

The grazing of domestic livestock in wolf habitats creates the potential for conflict and ultimately affects wolf populations negatively. This potential must be recognized in the context of agricultural policies. The costs of predator damage prevention, control and compensation programs should be considered when the expansion of agriculture activities into forested areas is proposed.

Crown land with current chronic wolf-cattle depredation problems will be identified. The Division will initiate discussions with the appropriate land management agencies and grazing disposition holders regarding management strategies to minimize wolf-cattle conflicts. In addition to discussing improved husbandry techniques, such things as obligatory removal of carrion, as required by the Livestock Diseases Act, 1971, will be stressed.

3.3.7.2 Control

The Division will maintain legislation to allow landowners, leaseholders and their designates to shoot wolves at any time of the year and without limit in order to protect their property.

Divisional policies relative to problem/nuisance wolf removal (Gurba and Neave 1979; Horstman and Gunson 1983) are as follows:

i) recreational/commercial trapping of wolves will be encouraged in depredation areas by education and liberal seasons,

ii) excepting cases involving rabies, wolf control will not be conducted for complaints of proximity to human habitation,

iii) where confirmed wolf predation on livestock or pets occurs in the agriculture-forest transition zone or residential areas of the province, control will be site-specific, but intensive. Method of control will be toxicants, with some use of trapping or shooting where applicable,

iv) strychnine baits will be employed. Every attempt will be made to minimize nontarget kills. Alternative toxicants that may provide greater selectivity will be used, if effective and available, and

v) control will not be conducted more than 19 km (12 mi.) into the Green Area.

3.3.7.3 Compensation

The Government of Alberta will continue to compensate losses of "livestock" (food-producing domestic animals) to wolves as provided in the existing Livestock Predator Compensation Program.

3.3.8 Control of Disease

The Division will monitor diseases and parasites of wolves, educate the public relative to these diseases and control diseases or wolf populations, where necessary.

3.3.8.1 Monitor Disease

Prevalence of mange (Sarcoptes scabiei), trichinosis (Trichinella sp.) and Echinococcus granulosus should be determined every three to five years. Wolf specimens from government control and selected trappers will be examined.

3.3.8.2 Education

The life history and significance of wolf diseases should be described to Albertans in a publication on wildlife diseases in Alberta.

3.3.8.3 Control

Where diseases or parasites of wolves are a threat to health of other wildlife species or to man, local wolf control will be conducted.

3.3.9 Education and Science

Public awareness and appreciation of the wolf resource will be increased by the following:

i) provision of written extension material that describes the natural history of wolves in Alberta,

ii) encouragement of "wolf howling" in certain provincial parks, wilderness areas and Natural Areas, and

iii) investigation of additional wolf populations and the effect of wolf predation in Alberta.

4.0 MANAGEMENT PLAN APPLICATION

4.1 Provincial Summary

Wolves were historically and are presently an important part of Alberta's faunal diversity. Wolf populations and natural wolf/prey relationships will be maintained in the forested north and west. Through official coordination, the province will provide assistance for wolf recovery south of the international border.

A primary challenge in wolf management in Alberta is to increase fur trapping and recreational hunting harvests to about 1200 wolves annually. This will be accomplished by assistance and incentives to fur trappers and by promotion of wolves as a prized huntable species. Of equal importance is the challenge to reduce wolf populations on a local basis in order to allow the growth of ungulate prey populations in specific areas. This will be accomplished by assistance to trappers through incentives and extension trappers. Secondary challenges in wolf management in Alberta include the promotion of the wolf as a valued member of the native fauna of the province, creation of improved opportunities to observe wolves in their natural habitat, and reduction of wolf predation on livestock and pets.

4.2 Regional Perspective

4.2.1 Southern Region

This region has few wolves. Major activities here will include implementation of a wolf observation registry and coordination of wolf management with agencies involved in wolf recovery in the Northern

Contintental Divide Ecosystem in the USA. Management of wolf-livestock depredation should emphasize prevention and compensation. Fur trapping and recreational hunting of wolves is not a priority in this region. Permanent, unmanipulated populations of wolves should be encouraged in Waterton Lakes National Park and the adjacent provincial forests.

4.2.2 Central Region

Central Region has fewer than 50 wolves in western portions where forest meets settlement. Fur trapping of wolves should be encouraged to limit livestock depredations. Recreational hunting of wolves is not a priority here.

4.2.3 Eastern Slopes Region

Approximately 1000 wolves occur in foothill and mountain habitats with a diverse, multiple-species prey base. The region has intense recreational activities and demand for recreational hunting of ungulates is high. Studies in mountainous habitats near Grande Cache and Nordegg indicate wolf predation is a major limitation to low and declining populations of mountain/woodland caribou and elk. Regional operational plans should be developed for the mountains north of the North Saskatchewan River and for the Willmore Wilderness-Grande Cache area, including wolf population reduction to restore caribou and elk populations to levels established in the respective management plans.

4.2.4 Peace River Region

Management of wolf-livestock predation has historically been central to wolf management strategies in this region. The

agriculture-forest transition zone is extensive here and wolf damage has occurred annually since the late 1960s. Coordinated land management is required to plan land use especially anticipated agricultural expansion such as grazing leases and allotments. Costs of wolf damage control need to be considered in development plans. Effect of wolf predation on ungulate prey should be determined in additional areas that are within 100 km of settlement and in which demand for recreational or subsistence hunting is greatest. Wolf-ungulate predator-prey relationships should also be determined in cases of critical ungulate populations such as woodland caribou in the Caribou Mountains.

4.2.5 Northeast Region

As in Peace River Region, offending wolves will be controlled in instances of confirmed predation of livestock. Government should continue to encourage wolf harvests by trappers. Preliminary studies during 1976-78 indicated wolf predation was the major limitation to stable, but low-density moose populations in Wildlife Management Units 518 and 530. Further evaluation of moose-wolf and caribou-wolf relationships are required to develop a regional operational plan for recovery of these species.

5.0 LITERATURE CITED

Alberta Fish and Wildlife. 1982. Fish and wildlife policy for Alberta. Alberta Energy and Natural Resources, Fish and Wildlife Division, Edmonton, Alberta. 24 pp.

Alberta Fish and Wildlife. 1990. Management plan for elk in Alberta. Discussion draft, December, 1990. Alberta Fish and Wildlife Division. 181 pp.

Atkinson, K., and D.W. Janz. 1986. Effect of wolf control on black-tailed deer in the Nimpkish Valley on Vancouver Island. B.C. Min. Environ. Rep. 31 pp.

Ballantyne, E.E. 1957. Sylvatic rabies and its control in Alberta. Dept. Agric. Rep., Legislature Library, Edmonton, Alberta.

Ballantyne, E.E. 1958. Rabies control in Alberta wildlife. J. Vet. Med. 23:87-91.

Ballantyne, E.E., and J.G. O'Donoghue. 1954. Rabies control in Alberta. J. Am. Vet. Assoc. 125:316-326

Ballard, W.B., R.O. Stephenson and T.H. Spraker. 1981. Nelchina Basin wolf studies. Alaska Fish and Game, Fed. Aid in Wildl. Pest. Final Prog. Rep. Proj. W17-8-W17-11. 201 pp.

Ballard, W.B., J.S. Whitman and C.L. Gardner. 1987. Ecology of an exploited wolf population in south-central Alaska. Wild. Monogr. 98. 55 pp.

Banfield, A.W.F. 1974. The mammals of Canada. Univ. of Toronto Press, Toronto, Ont. 438 pp.

Bergerud, A.T. 1980. A review of the population dynamics of caribou and wild reindeer in North America. Pages 556-581 in Reimers, E., E. Gaara and S. Skjenneberg. (eds.) Proc. 2nd Int. Reindeer/Caribou Symp. Directoret for vilt og Ferskvannsfisk. Trondheim, Norway. 799 pp.

Bergerud, A.T., and J.P. Elliott. 1986. Dynamics of caribou and wolves in northern British Columbia. Can. J. Zool. 64:1515-1529.

Bjorge, R.R. 1980. Management and research of the wolf-livestock conflict in Alberta. Pages 72-74 in Proc. Vertebrate Pest Manage. Conf., Can. Pest Manag. Soc. Edmonton.

Bjorge, R.R. 1983. Mortality of cattle on two types of grazing areas in northwestern Alberta. J. Range Manage. 36:20-21.

Bjorge, R.R., and J.R. Gunson. 1983. Wolf predation of cattle on the Simonette River pastures in northwestern Alberta. Pages 106-111 in L.N. Carbyn (ed.). Wolves in Canada and Alaska: their status, biology and management. Can. Wildl. Serv. Rep. 45.

Bjorge, R.R., and J.R. Gunson. 1985. Evaluation of wolf control to reduce cattle predation in Alberta. J. Range Manage. 38:483-487.

Bjorge, R.R., and J.R. Gunson. 1989. Wolf population characteristics and prey relationships near Simonette River, Alberta. Can. Field-Nat. 103:327-344.

Burkholder, B.L. 1959. Movements and behavior of a wolf pack in Alaska. J. Wildl. Manage. 23:1-11.

Burpee, J. (ed.). 1907. York factory of the Blackfeet country: the journal of Anthony Henday, 1754-55. Proc. and Trans. Roy. Soc. Can. Ser. 3, Vol. 1. pp. 307-354.

Cahalane, V.H. 1963. A preliminary study of distribution and number of cougar, grizzly and wolf in North America. New York Zool. Soc. The Zool. Park. Bronx NY. 12 pp.

Carbyn, L.N. 1974a. Wolf population fluctuations in Jasper National Park, Alberta, Canada. Biol. Conserv. 6:94-101.

Carbyn, L.N. 1974b. Wolf predation and behavioral interactions with elk and other ungulates in an area of high prey diversity. Can. Wildl. Serv. Rep. 234 pp.

Carbyn, L.N. 1983. Management of non-endangered wolf populations in Canada. Acta. Zool. Fennica 174:239-243.

Clark, S.H. 1933. Report of the Game Commissioner. Dept. Agric. Ann. Rep. 45 pp.

Clarke, C.H.D. 1942. Wildlife investigations in Banff and Jasper National Parks in 1941. Can. Wildl. Serv. Rep. Ottawa. 38 pp.

Clarkson, P.L., K.P. Schmidt and J.R. Gunson. 1984. Evaluation of wolf-ungulate predation near Nordegg, Alberta: first year progress report, 1983-84. Alta. Fish and Wildl. Div. Rep. 55 pp.

Cole, P.J., W.P. Wynnyk and J.R. Gunson. 1977. Biological observations of wolves from the 1976-77 wolf control program. Alta. Fish and Wildl. Div. Rep. 23 pp.

Coues, E. 1897. New light on the early history of the greater northwest. The manuscript journals of Alexander Henry and David Thompson, 1799-1814. Vol. 2. Francis P. Harper, New York, NY. Pp. 632-746.

Cowan, I. McT. 1947. The timber wolf in the Rocky Mountain National Parks of Canada. Can. J. Res. 25:139-174.

Crete, M., and H. Jolicoeur. 1987. Impact of wolf and black bear removal on cow:calf ratio and moose density in southwestern Quebec. Alces 23:61-87.

Dekker, D. 1985. Elk population fluctuations and their probable causes in the Snake Indian Valley of Jasper National Park, 1970-1985. Alta. Nat. 15:49-54.

Dekker, D. 1986. Wolf, Canis lupus, numbers and colour phases in Jasper National Park, Alberta: 1965-1984. Can. Field-Nat. 100:550-553.

Dekker, D. 1989. Population fluctuations and spatial relationships among wolves (Canis lupus), coyotes (Canis latrans), and red foxes (Vulpes vulpes), in Jasper National Park, Alberta. Can. Field-Nat. 103:261-264.

Drew, M.L. 1984. Reproduction and transmission of the winter tick, Dermacentor albipictus Packard in central Alberta. MSc thesis. University of Alberta, Edmonton. 209 pp.

Edmonds, E.J. 1986. Draft restoration plan for woodland caribou in Alberta. Alta. Fish and Wildl. Div. Rep. 74 pp.

Edmonds, E.J., and M. Bloomfield. 1984. A study of woodland caribou (Rangifer tarandus caribou) in west-central Alberta, 1979-1983. Alta. Fish and Wildl. Div. Rep. 203 pp.

Elliott, J.P. 1985a. Kechika enhancement project of northeastern B.C. Wolf/ungulate management, 1984-85 Annual Report. British Columbia Min. of Environ. Wildl. Working Rep. No. WR-13. 26 pp.

Elliott, J.P. 1985b. Muskwa wolf management project of northeastern B.C. 1984-85 Annual Report. British Columbia Min. of Environ. Wildl. Working Rep. No. WR-14. 44 pp.

Farnell, R., and J. McDonald. 1987. The demography of Yukon's Finlayson caribou herd, 1982-1987. Yukon Ren. Res. Rep. 54 pp.

Floyd, T.J., L.D. Mech and P.A. Jordan. 1978. Relating wolf scat content to prey consumed. J. Wildl. Manage. 42:528-532.

Forsland, D.E. 1949. Report of the Game Superintendent. Alta. Dept. Lands and Mines, Ann. Rep., 1984. pp. 95-104.

Fritts, S.H. 1982. Wolf depredation on livestock in Minnesota. US Dept. Int. Fish and Wildl. Serv. Res. Publ. 145.

Fritts, S.H., and L.D. Mech. 1981. Dynamics, movements and feeding ecology of a newly protected wolf population in northwestern Minnesota. Wild. Monogr. 80. 79 pp.

Fritts, S.H. 1983. Record dispersal by a wolf from Minnesota. J. Mammal. 64:166-167.

Fuller, T.K., and L.B. Keith. 1980. Wolf population dynamics and prey relationships in northeastern Alberta. J. Wildl. Manage. 44:583-602.

Fuller, W.A. 1954. Wolf control operations, 1953-54. Can. Wildl. Serv. Rep. 17 pp.

Fuller, W.A. 1962. The biology and management of the bison of Wood Buffalo National Park. Can. Wildl. Serv. Wildl. Manage. Bull. Ser. 1. 52 pp.

Fuller, W.A., and N.S. Novakowski. 1955. Wolf control operations, Wood Buffalo National Park, 1951-52. Can. Wildl. Serv. Wildl. Manage. Bull. Ser. 1, No. 11.

Gasaway, W.C. 1989. Management of complex predator-prey systems in Alaska. Pages 124-135 in Wolf-prey Dynamics and Management Proceedings. Symposium at UBC, May 10-11, 1988. B.C. Environ. Wildl. Working Rep. WR-40.

Gasaway, W.C., R.O. Stephenson, J.L. Davis, P.E. Shepherd, and O.E. Burris. 1983. Interrelationships of wolves, prey and man in interior Alaska. Wildl. Monogr. 84.

Goldman, E.A. 1944. Classification of wolves. In the wolves of North America Pt. II. Pages 398-636. Am. Wildl. Inst. Washington, DC. 636 pp.

Green, H.U. 1951. The wolves of Banff National Park. Can. Dep. Resour. Dev., Natl. Parks Br., Can. Natl. Parks and Hist. Sites Serv. Rep. 47 pp.

Gunson, J.R. 1973. The 1972-73 wolf control program. Alta. Fish and Wild. Div. Rep. 19 pp.

Gunson, J.R. 1983a. Status and management of wolves in Alberta. Pages 25-29 in L.N.Carbyn (ed.). Wolves in Canada and Alaska: their status, biology, and management. Can. Wildl. Serv. Rep. 45.

Gunson, J.R. 1983b. Survey of wolf abundance in Fish and Wildlife Districts during 1982. Alta. Fish and Wildl. Div. Rep. 10 pp.

Gunson, J.R. 1983c. Wolf-ungulate predation in North America: review of major studies. Alta. Fish and Wildl. Div. Rep. 31pp.

Gunson, J.R. 1983d. Wolf predation of livestock in western Canada. Pages 102-105 in L.N. Carbyn (ed.). Wolves in Canada and Alaska: their status, biology and management. Can. Wildl. Serv. Rep. 45.

Gunson, J.R. 1984. Review of management and research of wolf-big game predation in Alberta. Alta. Fish and Wildl. Div. Rep. 24 pp.

Gunson, J.R. 1986a. Timber wolf. Pages 222-225 in Alberta wildlife trophies: official records of the Alberta Fish and Game Association 1963-1983. Alta. Fish and Game Assoc., Edmonton.

Gunson, J.R. 1986b. Wolves and elk in Alberta's Brazeau country. Bugle; winter 1986/87:29-33.

Gunson, J.R., P.L. Clarkson and K.P. Schmidt. in prep. Wolf population characteristics and prey relationships near Nordegg, Alberta. Alta. Fish and Wildl. Div.

Gunson, J.R., and R.M. Nowak. 1979. Largest gray wolf skulls found in Alberta. Can. Field-Nat. 93:308-309.

Gunson, J.R., and K.H. Dies. 1980. Sylvatic trichinosis in Alberta. J. Wildl. Dis. 16:525-528.

Gurba, J.B., and D.J. Neave. 1979. Problem wildlife management: Alberta Agric. and Alberta Energy and Nat. Resour. Rep. 24 pp.

Haber, G.C. 1977. Socio-ecological dynamics of wolves and prey in a subarctic ecosystem. Ph.D. Thesis. Univ. of British Columbia, Vancouver, B.C. 785 pp.

Hall, E.R., and K.R. Kelson. 1959. The mammals of North America. The Ronald Press, New York, NY. 546 pp.

Harrington, F.H., and L.D. Mech. 1979. Wolf howling and its role in territorial maintenance. Behavior LXVII:207-249.

Harris, R.B. 1981. The status of wolves in the Livingstone-Porcupine area of southern Alberta. Univ. Montana. Missoula. 33 pp.

Harris, R.B. 1982. Effects of elk migration and cattle distribution on wolf movements in southern Alberta. Univ. Montana. Missoula. 10 pp.

Hatter, I.W. 1988. Effects of wolf predation on recruitment of black-tailed deer on northeastern Vancouver Island. B.C. Min. Environ., Wildl. Rep. R-23. 82 pp.

Hauge, T.M., and L.B. Keith. 1981. Dynamics of moose populations in northeastern Alberta. J. Wildl. Manage. 45:573-597.

Hayes, R., P. Merchant and A. Baer. 1985. Wolf population research and management studies in the Yukon. 1983 Annual Rep. Yukon Fish and Wildl. Br. Rep.

Hayes, R., and R. Farnell. 1985. Wolf population research and management studies in the Yukon Territory. Part 2. Finlayson Caribou Herd Management Area. Yukon Fish and Wildl. Br. Rep. 25pp.

Holmes, J.C., and R. Podesta. 1968. The helminths of wolves and coyotes from the forested regions of Alberta. Can. J. Zool. 46:1193-1204.

Horstman, L.P., and J.R. Gunson. 1983. Wolf. Pages 2,1 - 2,11 in Prevention and control of wildlife damage in Alberta: manual for investigating officers. Alta. ENR Rep. 52.

Hutchings, E. 1985. Livestock predator compensation program. Alberta Agric. Agdex 684-9.

Huestis, E. 1945, 1951, 1953, 1957. Report of the Game Commissioner. Alta. Dept. Agric. Ann. Reps.

Huestis, E.S. 1954. Report to the predator control conference. Pages 181-183 in Minutes of the First Predator Control Conference, Aug. 31/Sept 1, 1954. Calgary. Can. Wildl. Serv., Edmonton, Alberta.

Janz, D., and I. Hatter. 1986. A rationale for wolf control in the management of the Vancouver Island predator-ungulate system, B.C. Wildl. Bull. No. B-45, 35 pp.

Jolicoeur, P. 1959. Multivariate geographical variation in the wolf Canis lupus L. Evolution 13:283-299.

Keith, L.B. 1974. Some features of population dynamics in mammals. Proc. Congr. Game Biol. 11:17-58.

Keith, L.B. 1983. Population dynamics of wolves. Pages 66-77 in L.N. Carbyn. (ed). Wolves in Canada and Alaska: their status, biology and management. Can. Wildl. Serv. Rep. 45.

Kelsall, J.P. 1968. The migratory barren-ground caribou of Canada. Can. Wildl. Serv. Monogr. No. 3. Queen's Printer, Ottawa.

Kemp, G.A. 1966. Wolf populations in northeastern Alberta. Alta. Fish and Wildl. Div. Rep. 10 pp.

Kolenosky, G.B. 1972. Wolf predation on wintering deer in east-central Ontario. J. Wildl. Manage. 36:357-369.

Kolenosky, G.B. 1983. Status and management of wolves in Ontario. Pages 35-40 in L.N. Carbyn (ed.). Wolves in Canada and Alaska: their status, biology and management. Can. Wildl. Serv. Rep. 45.

Larsen, D.G., and D.A. Gauthier. 1985. Management program draft proposal-options for increasing moose numbers, southern Yukon. Yukon Ren. Res. Rep. 45 pp.

Lynch, G. 1973. Status of moose management in Alberta. Alta. Fish and Wildl. Div. Rep. 45 pp.

Mattson, U., and R.R. Ream. 1980. A review of the wolf population in the Rocky Mountain region of the Canadian/USA border. Wolf Ecology Project, University of Missoula, Montana.

McCowan, D. 1950. Animals of the Canadian Rockies. MacMillan Can., Toronto, Ont. 300 pp.

McDougall, J. 1898. Path finding on plain and prairie: stirring scenes of life in the Canadian northwest. William Brigg, Toronto, Ont. 277 pp.

Mech, L.D. 1970. The wolf: ecology and behavior of an endangered species. Natural History Press. Doubleday, New York, NY. 384 pp.

Mech, L.D. 1973. Wolf numbers in the Superior National Forest of Minnesota. US Dep. Agric. For. Serv. Res. Pap. NC-97, St. Paul, MN. 10 pp.

Mech, L.D. 1975. Disproportionate sex ratio of wolf pups. J. Wildl. Manage. 39:737-740.

Mech, L.D. 1977a. Productivity, mortality, and population trends of wolves in northeastern Minnesota. J. Mammal. 58:559-574.

Mech, L.D. 1977b. Population trend and winter deer consumption in a Minnesota wolf pack. Pages 55-83 in Philipps, R., and C. Jonkel. (eds.). Proc. 1975 Predator Symposium. Bull. Montana For. Conserv. Exp. Stn., Univ. of Montana, Missoula, MT. 268 pp.

Mech, L.D., and P.D. Karns. 1977. Role of the wolf in a deer decline on the Superior National Forest. US Dep. Agric. For. Serv. Res. Pap. NC-148. St. Paul, MN. 23 pp.

Medjo, D., and L.D. Mech. 1976. Reproductive activity in nine- and ten-month old wolves. J. Mammal. 57:406-408.

Messier, F. 1987. Physical condition and blood physiology of wolves in relation to moose density. Can. J. Zool. 65:91-95.

Millar, W.N. 1916. The big game of the Canadian Rockies. Conserv. of fish, birds, and game. Proc. of Comm. Meet., 1-2 Nov. 1915. The Methodist Book and Publ. House, Toronoto, Ont. pp. 100-124.

Murie, A. 1944. The wolves of Mount McKinley, US Nat. Park Serv., Fauna Ser. No. 5. 238 pp.

Nolan, J.W., and M.W. Barrett. 1985. A preliminary study of moose calf mortality in northeastern Alberta. Alta. Environ. Centre 2600-BU1-1/R1.

Nowak, R.M. 1983. A perspective on the taxonomy of wolves in North America. Pages 10-19 in L.N. Carbyn (ed.). Wolves in Canada and Alaska: their status, biology and management. Can. Wildl. Serv. Rep. 45.

Olsen, S., and D. Epp. 1987. Summary of the 1986/87 wolf baiting program in the Rocky Mountain House Area. Alta. Fish and Wildl. Div. Rep. 43 pp.

Oosenbrug, S.M., and L.N. Carbyn. 1985. Wolf predation on bison in Wood Buffalo National Park. Can. Wildl. Serv. Rep. Edmonton, Alta. 264 pp.

Packard, J.P., and L.D. Mech. 1980. Population regulation in wolves. Pages 135-150 in Cohen, M.N., R.S. Malpass, and H.G. Klein. (eds.). Biosocial mechanisms of population regulation. Yale Univ. Press, New Haven, CT. 406 pp.

Peters, R.P. 1973. Wolf-sign: scents and space in a wide-ranging predator. Ph.D. Dis. Univ. Mich. 288 pp.

Peters, R.P., and L.D. Mech. 1975. Scent marking in wolves. Amer. Sci. 63:628-637.

Peterson, R.O. 1977. Wolf ecology and prey relationships on Isle Royale. US Natl. Park Serv. Fauna Ser. 11, Washington, DC. 210 pp.

Peterson, R.O. 1985. Ecological studies of wolves on Isle Royale, Ann. Rep., 1984-85. Michigan Tech. Univ., Houghton, Mich. 22 pp.

Peterson, R.O., T.D. Woolington and T.N. Bailey. 1984. Wolves of the Kenai Penninsula, Alaska. Wildl. Monogr. 88.

Pike, W. 1892. The barren-ground of northern Canada. MacMillan Co., New York.

Pimlott, D.H. 1961. Wolf control in Canada. Can. Aud. 23:145-152.

Pimlott, D.H. 1967. Wolf predation and ungulate populations. Am. Zool. 7:267-278.

Pimlott, D.H. 1975. The ecology of the wolf in North America. Pages 280-285 in M.W. Fox (ed.). The wild canids - their systematics, behavior and ecology. Van Nostrand, Reinhold Co.

Pimlott, D.H., J.A. Shannon, and G.B. Kolenosky. 1969. The ecology of the timber wolf in Algonquin Provincial Park, Ont. Dep. Lands and For. Res. Rep. Wildl. 87, Toronto. 92 pp.

Rausch, R.A. 1967. Some aspects of the population ecology of wolves, Alaska. Am. Zool. 7:253-265.

Ream, R.R., and U. Mattson. 1982. Wolf status in the northern Rockies. Pages 362-381 in Harrington, F., and P. Paquet. (eds). Wolves of the world: perspectives of behavior, ecology, and conservation. Noyes Publications, Park Ridge, NJ. 474 pp.

Ream, R.R., and R. Harris. 1986. Wolf movements in southern Alberta. Nat. Geog. Soc. Res. Rep. 21:405-409.

Ream, R., D. Pletscher, B. O'Gara, W. Brewster, C. Martinka and W. Ruediger. 1987. A prospectus for wolf monitoring and research in Montana. Wolf Studies Task Group. Univ. of Montana, Missoula.

Rippin, B. 1983. Status of moose in Northeast Region. Alta. Fish and Wildl. Div. Rep. 7 pp.

Rodney, W. 1969. Kootenai Brown; his life and times, 1839-1916. Gray's Publ. Ltd., Sidney, B.C. 251 pp.

Rowan, W. 1950. Winter habits and numbers of timber wolves. J. Mammal. 31:167-169.

Samuel, W.M. 1973. Mange in Alberta canids. The Alberta Trapper. VIII (Summer, 1973):11-12, IX (Fall, 1973):10.

Samuel, W.M. 1981. Attempted experimental transmission of sarcoptic mange (Sarcoptes scabiei, Acarina : Sarcoptidae) among red fox, coyote, wolf and dog. J. Wildl. Dis. 17:343-347.

Samuel, W.M., G.A. Chalmers and J.R. Gunson. 1978. Oral papillomatosis in coyotes (Canis latrans) and wolves Canis lupus) of Alberta J. Wildl. Dis. 14:165-169.

Schmidt, K.P., and J.R. Gunson. 1985. Evaluation of wolf-ungulate predation near Nordegg, Alberta: second year progress rep., 1984-85. Alta. Fish and Wildl. Div. Rep. 53 pp.

Smith, S.B. 1968. Non-resident moose hunting in Alberta - 1967. Alta. Lands-Forest-Parks-Wildlife 11:34-38.

Soper, J.D. 1948. Mammal notes from the Grande Prairie - Peace River Region, Alberta. J. Mammal. 29:49-64.

Soper, J.D. 1964. The mammals of Alberta. Hamly Press, Edmonton, Alta. 402 pp.

Spry, I.M. 1963. The Palliser expedition. MacMillan Can., Toronto, Ont. 310 pp.

Stelfox, J.G. 1955. Results of the big-game hunting season for 1955. Alberta Fish and Wildl. Div. Rep. 8 pp.

Stelfox, J.G. 1956. The presence of wolves in the Brazeau, Pembina, McLeod and Athabasca Rivers. Alta. Fish and Wildl. Div. Rep. 6 pp.

Stelfox, J.G. 1958. Predator management guide for wolf control managers. Alta. Fish and Wildl. Div. Rep. 8 pp.

Stelfox, J.G. 1964. Wolf management in biological District 3. Alta. Fish and Wildl. Div. Rep. 8 pp.

Stelfox, J.G. 1965a. 1965 wolf and coyote control program for northwestern Alberta (Biol. Dist 3). Alta. Fish and Wildl. Div. Rep. 17 pp.

Stelfox, J.G. 1965b. 1965-66 wolf and coyote control program for northwestern Alberta (Biol. Dis 3). Alta Fish and Wildl. Div. Rep. 6 pp.

Stelfox, J.G. 1966. Wolf populations in northwestern Alberta. Alta. Fish and Wildl. Div. Rep. 12 pp.

Stelfox, J.G. 1969. Wolves in Alberta: a history 1800-1969. Alta. Lands, Forest, Parks, Wildlife 12:18-27.

Stephenson, R.O. 1978. Unit 13 wolf studies. Alaska Fed. Aid. Wildl. Rest. Prog. Rep. Proj. W-17-8. 75 pp.

Theberge, J.B. 1973. Wolf management in Canada through a decade of change. Nat. Can. 2:3-10.

Timm, R.M. (ed.). 1983. Prevention and control of wildlife damage. Great Plains Agric. Council and Nebraska Coop. Ext. Serv. Univ. Nebraska-Lincoln.

Todd, A.W. 1981. Ecological arguments for fur-trapping in boreal wilderness regions. Wildl. Soc. Bull. 9:116-124.

Todd, A.W., and L.C. Geisbrecht. 1979. A review of Alberta fur production and management, 1920-21 to 1977-78. Alta. Fish and Wildl. Div. Rep., Edmonton. 28 pp.

Todd, A.W., J.R. Gunson and W.M. Samuel. 1981. Sarcoptic mange, an important disease of coyotes and wolves of Alberta. Pages 706-729 in Chapman, J.A., and D. Pursley. (eds.). Proc. Worldwide Furbearer Conf. Frostburg, MD.

Tompa, F.S. 1983. Problem wolf management in British Columbia: conflict and program evaluation. Pages 112-119 in L.N. Carbyn (ed.). Wolves in Canada and Alaska, their status, biology and management. Can. Wildl. Serv. Rep. 45.

United States Fish and Wildlife Service (USFWS). 1987. Northern Rocky Mountain Wolf Recovery Plan. USFWS, Denver, Colorado. 119 pp.

Van Ballenberge, V., and L.D. Mech. 1975. Weights, growth and survival of timber wolf pups in Minnesota. J. Mammal. 56:44-63.

Van Ballenberghe, V., A.W. Erickson and D. Byman. 1975. Ecology of the timber wolf in northeastern Minnesota. Wildl. Monogr. 43:1-43.

Van Camp, J., and R. Gluckie. 1979. A record long-distance move by a wolf (Canis lupus). J. Mammal. 60:236-237.

Voigt, D.R., G.B. Kolenosky and D.H. Pimlott. 1976. Changes in summer foods of wolves in central Ontario. J. Wildl. Manage. 40:663-668.

Weaver, J.L. 1978. The wolves of Yellowstone. USGPO NPS National Research Report No. 14. 38 pp.

Weaver, J.L. 1983. Of wolves and livestock. Western Wildlands 8:37-39.

Weaver, J.L. 1986. Wolf-livestock relationships: a profile and perspective. Pages 81-91 in draft Northern Rocky Mountain Wolf Recovery Plan. US Fish and Wildl. Serv., Denver, Colorado.

Williams, M.Y. 1946. Notes on the vertebrates of the southern plains of Canada; 1923-1926. Can. Field-Nat. 60:47-60.

Wolfe, M.L., and D.L. Allen. 1973. Continued studies of the status, socialization, and relationships of Isle Royale wolves, 1967-1970. J. Mammal. 54:611-635.

Wobeser, G.A. 1985. Handbook of diseases of Saskatchewan wildlife. Sask. Parks and Ren. Res. 65 pp.

Zimen, E. 1976. On the regulation of pack size in wolves. Zeit. Fur Tierpsych. 40:300-341.

Zimen, E., and L. Boitani. 1979. Status of the wolf in Europe and the possibilities of conservation and reintroduction. Pages 43-83 in Klinghammer E. (ed.). Proceedings of the behavior and ecology of wolves. Garland STPM Press, New York, NY.

APPENDIX I Report of the Chief Game Guardian, Mr. B Lawton, in the 1907 Annual Report of the Alberta Department of Agriculture. This report provides an interesting insight into wolf management eighty years ago.

The direct supervision of the carrying out of the Wolf Bounty Regulations was placed in the hands of the chief game guardian, Mr. B. Lawton, and the following is his report thereon:

REPORT ON WOLF BOUNTY.

The amount paid for bounty on coyotes and timber wolves under the above regulations as shown by warrants received up to and including the 31st day of December was $3,598.70. This, together with $1,030.00 paid by the department on timber wolves through the Western Stock Growers' Association, makes in all a total of $4,628.70 expended during the year 1907 for the destruction of wolves.

There were 102 inspectors appointed for the purpose of inspecting pelts and issuing warrants during 1907. This number is being gradually increased in order that the settlers may not have to travel too far to claim bounty. During the months of November and December the average amount claimed under bounty regulations was almost one hundred dollars per day.

The present regulations are not as stringent as they should be. The experience in other provinces and states where a bounty is paid on wolves has been that even the most drastic laws have failed to entirely eliminate dishonest practices. The State of Washington estimates that during the year 1906 over four thousand dollars were fraudulently obtained by parties claiming bounty. The State of Montana also had trouble in this respect. It is also stated that parties have claimed from the Province of Saskatchewan bounty on coyotes killed in this province. Attempts have also been made by residents of the province to collect bounty on the pelts of timber wolves killed elsewhere.

As the depredations of timber wolves and coyotes cause a loss to the settlers of this province amounting to many thousands of dollars annually a few remarks as to the best and most successful manner of capturing or destroying them will no doubt prove of interest.

The hunter and trapper prefers of course to take the pelts of these animals between the first day of November and the first day of March while the fur is at its best. The price realized on pelts taken during this time runs from one to two

dollars on coyotes and five to seven dollars for timber wolves. The bounty of one dollar on coyotes and ten dollars on timber wolves, in addition to the value of the pelt as fur, will no doubt be an inducement for them to give the hunting of these animals more attention. The farmer and rancher of course desire their destruction not for the sake of the fur or bounty but to prevent damage to their stock and poultry. The most effective way of doing this is to destroy the pups. Any person who knows the country adjacent to their place of residence may readily locate their dens by studying the lay of the country.

For breeding dens they choose, if possible, natural cavities or washed out hollows on the southern slopes of rocky or bad land ridges. There is usually a high point not far from the den where the male is on guard during the day. Good tracking snow often lies on the ground during the early part of the breeding season, which renders the finding of the dens much easier; even on bare ground there is little trouble in locating these dens.

By riding along ridges until the tracks are found, the direction of the den can be often located by the lay of the land. Near the den the tracks become more perceptible and often gather into well worn trails.

Coyotes make their dens in the same kind of places as wolves, and also dig burrows or use old badger holes, slightly enlarged, and in order to reach them a shovel is often necessary. Farmers or ranchers should not allow wolf or coyote pups to grow up on or near their lands. A short time spent in trying to locate them will usually meet with success and it is up to everyone to try to protect himself by destroying them. The young pups of wolves and coyotes are nearly black, but as they grow older the colour fades to dull yellow, and when about three months old a new light grey coat is acquired.

Trapping Wolves.

For trapping these pests it is advisable to use a No. 4 double spring trap for wolves and a No. 3 for coyotes, with an extra stout chain and swivel. If in a timber wolf country it will be better to use the No. 4 trap as this will hold either and may prevent the loss of the trap. If possible attach the trap to a drag. If it is found necessary to stake the trap, it may be done by driving the stake just below the surface of the ground and adjusting it in such a manner that the chain will not slip off.

If possible the trap should be placed in such a position that it can be approached from one direction only. It should be near their runway and covered in such a manner that no portion of the trap or chain is visible. This may be done by covering the trap with a piece of paper, which in turn should be sprinkled with sufficient fine dirt to cover it, and by sprinkling with water, a natural appearance may be secured. Care should be taken to leave the ground in a condition as to appear as if it had not been disturbed.

Wearing old gloves well scented as well as rubbing the soles of the shoes with tainted meat will prevent suspicion due to any human scent being left behind. A piece of old sacking or a cow hide may be used to stand on or to pile the loose dirt on while burying the trap. Meat baits alone have not proven successful in capturing these suspicious and cunning animals. Of scents and combinations the fetid bait has proven most successful. This is prepared by putting a piece of raw meat in a wide-mouthed bottle or jar and placing it in a warm shady place. Allow it to stand until the odor therefrom has become almost unbearable, when a quart of lard oil and 1 oz. of tincture of musk may be added to each half pound of meat. Pour a little of this on the ground in such a position that the animal to be trapped cannot get to it without first crossing the trap. This bait is very attractive to domestic animals and care should be taken that they cannot gain access to it.

Poisoning is a very common, as well as successful, way of destroying these pests. Great care of course must always be taken that domestic animals do not have an opportunity of partaking of poisonous baits. Provided it is taken in proper quantity, pure sulphate of strychnine has proven to be the most effective poison for this purpose. For coyotes 2 grains and wolves 4 grains, has proven to be the most effective dose. It should be enclosed in capsules of 2 and 3 grain capacity respectively and every trace of the contents wiped from the outside. Each capsule should be inserted into a piece of beef suet about the size of a walnut. Never use lean meat as the juice therefrom will dissolve the capsule and free the poison before it is partaken of by the animal for which it is intended. The baits may be carried in a tin can or pail and dropped while riding along on horseback, care always being taken that the bare hand or the clothing does not come in contact with the bait. This may be prevented by wearing gloves which have been scented. After deciding as to where these baits shall be placed, the trail may be scented by dragging an old bone or piece of meat which has been previously scented. The baits may also be placed near a carcass or along a trail frequently travelled by the wolves.

Hunting with dogs has proven more successful with coyotes than with the timber wolf. The large greyhound or wolfhound which runs by sight and hunts in pairs will readily overtake and kill the coyote, but they would be no match for a full grown timber wolf. By watching at the den in the early morning or late evening during the breeding season, the hunter may secure one or both of the parents.

Fencing.

Fencing against wolves and coyotes has been adopted to some extent. Owing to the expense it is not feasible to enclose anything but areas such as would be suitable for swine, or small numbers of sheep and calves, or other animals which would not require a large range, or might be used for a night enclosure for any kind of stock. A fence for this purpose should be built as follows and would, I think, prove effective in keeping out almost all carnivora.

Woven wire stretched on posts set a rod apart, with a closely barbed wire just along the surface of the ground. The woven wire should be about 3 inches above this and 36 inches high, the mesh of which should not exceed five inches. Above this should be placed two more barbed wires, not more than six inches apart. In a district where the snowfall is at all heavy, still another barbed wire should be used, and placed five feet from the ground. To prevent sagging a vertical wire or dropper may be placed between each post. For poultry it will be necessary to place lightweight netting immediately above the heavy netting mentioned and to such a height as to prevent the possibility of the birds enclosed flying over it.

The following is a list of the inspectors, arranged according to electoral districts as shown by their post office addresses: